Archives of
PHYSICAL MEDICINE

Official Journal American Congress of Physical Medicine

(Formerly Archives of Physical Therapy)

EDITORIAL BOARD

EARL C. ELKINS, M.D.
Rochester, Minn.

RICHARD KOVACS, M.D.
New York, N. Y.

FRED B. MOOR, M.D.
Los Angeles, Calif.

GEORGE M. PIERSOL, M.D.
Philadelphia, Pa.

WALTER M. SOLOMON, M.D.
Cleveland, Ohio

ARTHUR L. WATKINS, M.D.
Boston, Massachusetts

Copyright, 1950, by The American Congress of Physical Medicine

29th Annual Session

AMERICAN CONGRESS OF PHYSICAL MEDICINE

September 4, 5, 6, 7, 8, 1951

SHIRLEY-SAVOY HOTEL DENVER, COLORADO

VOLUME XXXI NOVEMBER, 1950 No. 11

STANDARD OF EXCELLENCE IN MEDICAL CIRCLES

For Office Practice - - - -

For Hospital Practice

HANOVIA **NEW, Approved Medical**

DIATHERMY

Designed to deliver adequate power for the heaviest duty and extraordinary flexibility of application, projects a new standard in Diathermy equipment. Can be used with *any* of the approved types of applicators — air spaced pads, induction cable, drums or special drum applicators, cuff electrodes and for minor electro surgery.

EASY TO USE!

A single pair of outlets provides connection to any applicator, simplifying control, avoiding confusion and operating difficulties.

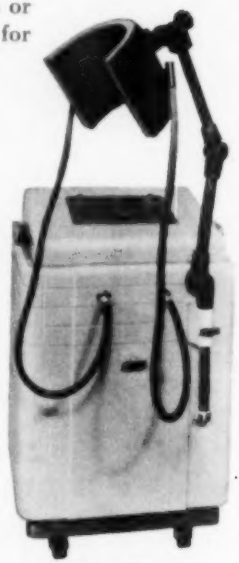
FINGER TIP CONTROL

Easy to tune—the tuning adjustment requires only the slightest attention for use with any given applicator. Output power is controlled independently of the tuning.

NEW LOOK

Modern design. Beautifully finished in acid-proof baked enamel, enhancing the appearance of any office.

Further details on request. Send for them today.



Cat. No. 27300R

HANOVIA CHEMICAL & MFG. CO.

Dept. 306-L. **Newark 5, N. J.**

Contents—Nov. 1950

Volume XXXI No. 11

ARCHIVES OF PHYSICAL MEDICINE
(Formerly Archives of Physical Therapy)
30 North Michigan Avenue, Chicago 2, Illinois

Original contributions, exchanges and books for review should be forwarded to the Editorial Office. All business matters including advertising should be handled through the Executive Office, 30 N. Michigan Ave., Chicago 2, Illinois. The statements in the manuscripts published in the ARCHIVES OF PHYSICAL MEDICINE are made solely on the responsibility of the author. The American Congress of Physical Medicine does not assume any responsibility for statements contained therein. Manuscripts accepted for publication in ARCHIVES OF PHYSICAL MEDICINE are for exclusive publication and may not be published elsewhere.

OFFICERS
American Congress of Physical Medicine
ARTHUR L. WATKINS, M.D., Boston, President.
ROBERT L. BENNETT, M.D., Warm Springs, Ga., President-Elect.
WALTER M. SOLOMON, M.D., Cleveland, First Vice-President.
WILLIAM B. SNOW, M.D., New York, N. Y., Second Vice-President.
WILLIAM D. PAUL, M.D., Iowa City, Iowa, Third Vice-President.
HOWARD A. RUSK, M.D., New York, N. Y., Fourth Vice-President.
GORDON M. MARTIN, M.D., Rochester, Minn., Fifth Vice-President.
RICHARD KOVACS, M.D., New York, N. Y., Secretary.
FRANK H. KRUSEN, M.D., Rochester, Minn., Treasurer.
WALTER J. ZEITER, M.D., Cleveland, Executive Director.
MARION G. SMITH, B.S., Chicago, Executive Secretary.

EXECUTIVE COUNCIL
Earl C. Elkins, M.D., Rochester, Minn., *Chairman.*
Norman E. Titus, M.D., Downington, Pa., *Secretary.*
William Bierman, M.D., New York, N. Y.
Roy W. Fouts, M.D., Omaha, Nebraska.
Kristian G. Hansson, M.D., New York, N. Y.
John Severy Hibben, M.D., Pasadena.
Abraham R. Hollender, M.D., Miami Beach, Fla.
O. Leonard Huddleston, M.D., Santa Monica, Calif.
H. Worley Kendell, M.D., Chicago.
Miland E. Knapp, M.D., Minneapolis, Minn.
Distaeli Kobak, M.D., Chicago.
Frank H. Krusen, M.D., Rochester, Minn.
Walter S. McClellan, M.D., Saratoga Springs, N. Y.
Fred B. Moor, M.D., Los Angeles.
Nathan H. Polmer, M.D., New Orleans.
William H. Schmidt, M.D., Philadelphia.
Frederick L. Wahrer, M.D., Marshalltown, Ia.
Arthur L. Watkins, M.D., Boston, Ex-Officio.

EDITOR EMERITUS
Distaeli Kobak, M.D., Chicago.

Subscription — In the United States, its possessions, and Mexico, $7.00 yearly; Canada, $8.00; elsewhere, $14.00 the year.

Advertising rates on application. All advertising copy subject to acceptance by publication committee.

COPYRIGHT: Matter appearing in the ARCHIVES OF PHYSICAL MEDICINE is covered by copyright. Permission will be granted on request for reproduction in reputable publications if proper credit is given. Reproduction for commercial purposes will not be permitted.

Published monthly at Chicago, Illinois, by American Congress of Physical Medicine.

Entered as Second Class Matter, February 15, 1945, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

ORIGINAL ARTICLES

Temperatures Produced in Bone Marrow, Bone and Adjacent Tissues by Ultrasonic Diathermy. An Experimental Study. Paul A. Nelson, M.D.; J. F. Herrick, Ph.D., and Frank H. Krusen, M.D. 687

Physical Medicine in the Treatment of Shoulder Disabilities. K. G. Hansson, M.D. 696

Orthopedic Aspects of Shoulder Disabilities. Carl Berg, M. D. 703

Suction Socket Prosthesis for the Above Knee Amputee. John H. Aldes, M.D. 709
Discussed by Dr. Harold Dinken.

An Evaluation of Various Methods of Heating Vaginal and Adjacent Tissues. R. N. Miller, M.D.; Steven M. Horvath, Ph.D.; C. Day, M.D.; F. X. Sweeney, M.D.; A. Rubin, M.D.; H. Mellette, B.S.; F. Smith, R.P.T., and B. K. Hutt, R.P.T. 721

•

Medical News 726

•

Editorials 727

•

Book Reviews 732

•

Physical Medicine Abstracts 737

•

EDITOR OF THE MONTH

FRED B. MOOR, M.D.
Los Angeles, Calif.

Printed in U. S. A.

APPROVED SCHOOLS FOR PHYSICAL THERAPISTS *

Council on Medical Education and Hospitals of the American Medical Association

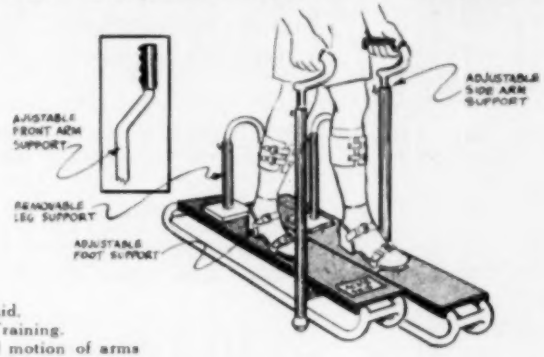
Name and Location of School	Medical Director and Technical Director	Entrance Requirements **	Duration of Course	Time of Admission	Maximum Enrollment	Tuition	Certificate, Diploma, Degree
Childrens Hospital, Los Angeles[1]	S. S. Mathews, M.D. Mrs. Sarah S. Rogers	a-b-d	18 mos.	Sept	14	$360	Cert. or Degree
College of Medical Evangelists, Los Angeles[1]	Fred B. Moor, M.D. R. William Berdan	a-b-c	18 mos.	Sept	16	$300	Cert. or Dipl.
University of Southern California, Los Angeles[1, 14]	Charles L. Lowman, M.D.	a-b-e	14 mos.	Sept	20	$394	Certificate
University of California Hospital, San Francisco[1]	Miss Charlotte W. Anderson	c-d-H.S.	1-4 yrs.	Sept-Feb		$16 per unit	Cert. & Degree
Stanford University, Stanford University, Calif.[1]	Lucile M. Eising, M.D. Mrs. Margery L. Wagner	d	12 mos.	Sept	16	$220[2]	Cert. or Degree
University of Colorado Medical Center, Denver[1]	W. H. Northway, M.D. Miss Lucille Daniels	a-b-d	12 mos.	Varies	15	$220	Cert. or Degree
Northwestern University Medical School, Chicago	Harold Dinken, M.D. Miss Mary Lawrence	a-b-d	12 mos.	Sept	12	$300[3]	Cert. or Degree
State University of Iowa Medical School, Iowa City[1]	Emil D. W. Hauser, M.D. Miss Gertrude Beard	a-b-d	12 mos.	Oct	16	$450	Certificate
University of Kansas School of Medicine, Kansas City[1]	W. D. Paul, M.D. Mrs. Olive Farr	e	12 mos.	Sept	15	$200	Certificate
Bouvé-Boston School of Physical Education, Medford, Mass.	Donald L. Rose, M.D. Mrs. Ruth G. Monteith	a-b-d	12 mos.	Feb-Sept	14	$ 80[3]	Cert. or Degree
Simmons College, Boston	Howard Moore, M.D. Miss Constance Greene	H.S.	4 yrs.	Sept	15	$550	Dipl. & Degree
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	W. T. Green, M.D. Miss Janet B. Merrill	H.S.-e	1½-4½ yrs.	Sept	25	$550	Dipl. or Degree
University of Minnesota, Minneapolis[1]	Kenneth Christophe, M.D. Miss Adelaide McGarrett	H.S.-e-d	1-4 yrs.	Sept	30	$450	Cert. or Degree
Mayo Clinic, Rochester, Minn.[1]	M. E. Knapp, M.D. Miss Ruby M. Green	H.S.	4 yrs.	Sept	16	$580[3]	Degree
Washington Univ. School of Medicine, St. Louis[1]	Earl C. Elkins, M.D. Harry Krowen	a-e	12 mos.	Sept	30	None	Certificate
St. Louis University School of Nursing, St. Louis[1]	Sedgwick Mead, M.D. Miss Beatrice Schulz	c	2 yrs.	Sept	12	$775[15]	Degree
Albany Hospital, Albany, N. Y.	A. J. Kotkis, M.D. Sister Mary Imelda	H.S.	4 yrs.	Jan-Sept	10	$300	Degree
Columbia University College of Physicians and Surgeons, New York City[1]	J. W. Ghormley, M.D. Miss Catherine Graham	a-b-d	12 mos.	Sept	8	$250	Certificate
New York University School of Education, New York City[1]	William B. Snow, M.D. Miss Floy Pinkerton	a-c-e	1-2 yrs.	Sept	50	$710	Cert. or Degree
Duke Hospital, Durham, N. C.[1]	George G. Deaver, M.D. Miss Elizabeth Addoms	a[7]-b-d	12 mos.	Sept	40	$600	Cert. & Degree
D. T. Watson School of Physiatrics, Leetsdale, Pa.[1]	Lenox D. Baker, M.D. Miss Helen Kaiser	a-b-d	18 mos.	Oct	12	$350	Certificate
Graduate Hospital of the University of Pennsylvania, Philadelphia[1]	Jessie Wright, M.D. Miss Kathryn Kelley	a-b-d	12 mos.	Oct	30	$300	Diploma
University of Texas School of Medicine, Galveston[1]	George M. Piersol, M.D. Miss Dorothy Baethke	a-b-d	12 mos.	Sept	20	$400	Certificate
Hermann Hospital, Houston[1]	G. W. N. Eggers, M.D. Miss Ruby Decker	b-d	12 mos.	Jan	8	$163[3]	Certificate
Baruch Center of Physical Medicine of the Medical College of Virginia, in affiliation with Richmond Professional Institute, Richmond[1]	Oscar O. Selke, Jr., M.D. Mary Elizabeth Kolb	a-b-d	12 mos.	Oct	12	$300	Cert. or Degree
University of Wisconsin Medical School, Madison	Walter J. Lee, M.D. Miss Susanne Hirt	H.S.-a-b-c-d-e	1-4 yrs.	Sept	54	$275[3]	Dipl. or Degree
Medical Department — U. S. Army — Medical Field Service School, Brooke Army Medical Center, San Antonio, Texas, and	Harry Bouman, M.D. Miss Margaret A. Kohli	a-b-c H.S.	12 mos. 4 yrs.	Feb-Sept Sept	20 20	$120[13]/yr $120[13]/yr	Certificate Cert. & Degree
Fitzsimons Army Hospital, Denver, Colorado	James E. Tate, Lt. Col., M.C.	h	12[13]	Nov.	20	None	See Below
or	Agnes P. Snyder, Major, WMSC Harold B. Luscombe, Col., M.C.	Completion MFSS	12[13]	June	10	None	Certificate
Walter Reed Army Hospital, Army Medical Center, Washington, D. C.	Olena M. Cole, Capt., WMSC John H. Kuitert, Colonel, M.C.	Completion MFSS	12[13]	June	10	None	Certificate
Permanente School of Physical Therapy, Oakland, Calif.	Barbara Robertson, Capt., WMSC O. Leonard Huddleston, M.D.	a-b-d	12 mos.	July	20	$200	Certificate
Cleveland Clinic Hospital, Cleveland, Ohio	Miss Dorothy Hoag Shelby G. Gamble, M.D.	a-b-d	12 mos.	Oct	12	$200	Diploma
	Miss Mildred Heap						

** Courses are so arranged that any of the entrance requirements will qualify students for training.
a — Graduation from accredited school of nursing; b — Graduation from accredited school of physical education; c — Two years of college with science courses; d — Three years of college with science courses; e — Four years of college with science courses. H.S. — High school graduation. b — Baccalaureate degree with major in physical education or the biological sciences.

* Reprinted in part with permission, J. A. M. A. 140:103 (May 7) 1949.

1. Male students are admitted.
2. R.N. plus one year college.
3. Nonresidents charged additional fee.
13. 12 months includes training at the Medical Field Service School and Fitzsimons or Walter Reed General Hospitals.
14. Students may transfer into the degree course at the Freshman, Sophomore, Junior or Senior Level. All are held responsible for requirements as listed in curriculum outline. This refers to professional as well as nonprofessional courses.
15. First year—$450. Second year—$325.

ACME SKIS—RECIPROCAL MOTION
for Cerebral Palsied Children



PURPOSE:

1. Walking aid.
2. Balance Training.
3. Reciprocal motion of arms and legs in walking pattern.

OTHER FEATURES OF THE ACME SKIS:
(In addition to those shown with lines)

1. Turning is possible.
2. Turning movement is eliminated if the side stop attachment is used.
3. The length of the steps can be regulated.
4. The leg supports are adjustable. May be turned aside if not needed or removed entirely.

For Further Information Write:

ACME SKIS
2805 S. Fairfax Ave.
Los Angeles 16, California

D—491

F. C. C. TYPE APPROVED

R. A. FISCHER & CO.
Manufacturer of
ELECTRO-THERAPY EQUIPMENT
517 Commercial St., Glendale 3, Calif.

By Comparison

THE NEW MASTER FISCHERTHERM

Model 1200

is

THE OUTSTANDING VALUE IN
F.C.C. TYPE APPROVED DIATHERMIES
MORE POWER FOR LESS MONEY

APPROVED BY
BOARD OF BUILDING AND SAFETY COMMISSIONERS
CITY OF LOS ANGELES
No. 4463

Department of Transport. Canada. Radio Division. Listed No. 47.

Literature please:
☐ Master Fischertherm
☐ Catalogue
☐ Have representative call

NAME.....
ADDRESS.....
CITY..... STATE.....

APPROVED SCHOOLS FOR OCCUPATIONAL THERAPISTS

Council on Medical Education and Hospitals of the American Medical Association

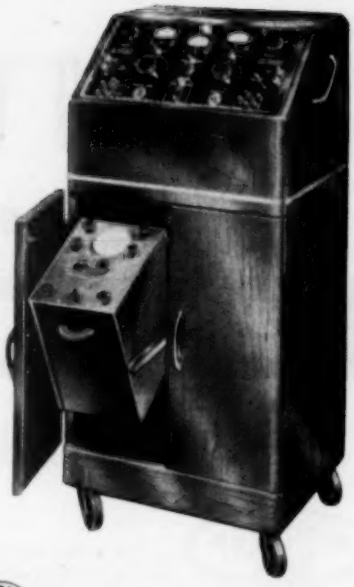
NOTE: The duration of the course is expressed in academic years.

Name and Location of School	College Affiliation	Duration of Course	Classes Start	Entrance Requirements	Tuition Per Year	Certificate, Diploma	Graduates in 1947
University of Southern California, 923½ 35th Place, Los Angeles	University of Southern California	2 yrs. 5 yrs.	FebSept FebSept	Degree High sch.	$420 $450	Certificate Cert.&B.S.	22
Mills College, Oakland, Calif.	Mills College	3 yrs.	FebSept	Degree	$200 $550	Certificate	—
San Jose State College, San Jose, Calif.	San Jose State College	1½ yrs. 3¼ yrs.	Varies Varies	Degree High sch.	$ 21 $ 21	Certificate Degree	10
University of Illinois College of Medicine, 1853 W. Polk St., Chicago	University of Illinois	5 yrs.	Feb	High sch.	$152	B.S.	14
University of Iowa, Iowa City, Iowa	State University of Iowa, College of Medicine	5 yrs.	.....	High sch.	$ 85	Cert.&Deg.	
University of Kansas, Lawrence	University of Kansas	2 yrs. 4 yrs.	FebSept FebSept	Degree High sch.	$131 $131	Certificate B.S.	10
Boston School of Occupational Therapy, 7 Harcourt St., Boston	Tufts College	2 yrs. 5 yrs.	Sept Sept	Degree High sch.	$500 $450	Diploma B.S.	13
Wayne University, 4841 Cass, Detroit, Mich.	Wayne University, College of Med., Coll. of Liberal Arts, Coll. of Education	5 yrs.	.....	High sch.	.....	.....	
Kalamazoo School of Occupational Therapy, Western Michigan College of Education, Kalamazoo	Western Michigan College of Education	1½ yrs. 4 yrs.	FebSept FebSept	Degree 1 yr. coll.	$127 $127	Diploma Degree	20
Michigan State Normal College, Ypsilanti	University of Michigan	5 yrs.	Varies	High sch.	$118	Cert.&Deg.	8
University of Minnesota, Church Street, Minneapolis	University of Minnesota	4 yrs.	.....	High sch.	$360	B.S.	
College of St. Catherine, St. Paul, Minn.	The College of St. Catherine	3½ yrs.	Varies	1 yr. coll.	$210	Degree	4
Washington University School of Medicine, St. Louis	Washington University	3 yrs.	Sept	2 yrs. coll.	$400	Degree	10
University of New Hampshire, Durham	Univ. of New Hampshire	5 yrs.	Sept	High sch.	$160	Cert.&Deg.	6
Columbia University College of Physicians and Surgeons, 630 W. 168th St., New York City	Columbia University	1½ yrs. 2½ yrs.	Sept Sept	Degree 2 yrs. coll.	$450 $450	Certificate Degree	28
New York University School of Education, 100 Washington Sq. E., New York City	New York University	4½ yrs.	FebSept	High sch.	$500	Cert.&Deg.	20
Ohio State University, Columbus	Ohio State University	3 yrs.	Quarterly	High sch.	$105	Degree	21
Philadelphia School of Occupational Therapy, 419 S. 19th St., Philadelphia	University of Pennsylvania	1½ yrs. 3 yrs.	Sept Sept	Degree 1 yr. coll. High sch.	$500 $500 $600	Diploma Diploma	35
Texas State College for Women, Denton, Tex.	Texas State College for Women	5 yrs.	FebSept	High sch.	$150	Degree	13
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.	Medical College of Virginia	1½ yrs. 3 yrs.	Sept Sept	Degree 1 yr. coll.	$200 $200	Certificate Certificate	20
College of Puget Sound, Tacoma, Wash.	College of Puget Sound	3 yrs. 5 yrs.	FebSept FebSept	Degree High sch.	$350 $300	Certificate Cert.&Deg.	
University of Wisconsin, Madison	University of Wisconsin	4 yrs.	FebSept	High sch.	$320	Cert.&Deg.	8
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford, Milwaukee	Milwaukee-Downer College	2½ yrs. 4 yrs.	Sept Sept	1 yr. coll. High sch.	$300 $300	Diploma Dipl.&Deg.	22
Mount Mary College, 2900 Menomonee River Dr., Milwaukee		Varies	Sept	Degree	$335	Certificate	15
University of Toronto, Dept. of University Extension, Toronto, Ont., Canada	University of Toronto	5 yrs. 3 yrs.	Sept Sept	High sch. 1 yr. coll.	$260 $222	B.S.Deg. Diploma	110
Colorado Agricultural and Mechanical College, Fort Collins, Colorado		5 yrs.	Sept	High sch.	.....	B.S.	

TECA CD4

a low price generator with variable frequencies for conventional low-volt therapy

- Muscle Stimulation
- Ion-Transfer Therapy
- Electro Diagnosis
- Medical Galvanism



AVAILABLE CURRENTS:

A. C., from 18 to 3000 cycles per second in sine wave and square wave.
D. C., straight and any desired degree of pulsation.

ALL CURRENTS SURGING, from 6 to 60 surges per minute.

SUPERIMPOSED CURRENTS, any alternating current can be superimposed on any direct current, or vice versa.

OSCILLOSCOPE, optionally, CD4 may be equipped with a 3" oscilloscope.

TWO CIRCUITS, separate circuits and controls for A. C. and D. C. for easier operation and wider range of application.

For literature, price, demonstration, write. . . .

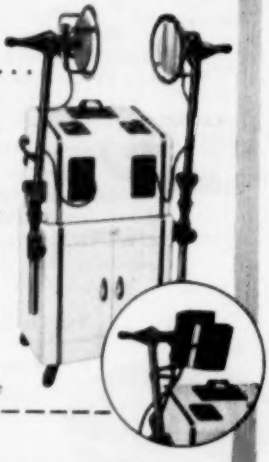
TECA CORPORATION 220 WEST 42ND ST., NEW YORK 18, N. Y.

Simple To Operate
Reliable • Efficient

FOR *Best* PERFORMANCE . . .

THE L-F MODEL SW-227 *Diathermy*

INVESTIGATE the diathermy unit preferred by most doctors and hospitals! Send the coupon below for detailed literature.



Applicators Interchangeable

Liebel-Flarsheim Co.
Cincinnati 2, Ohio

Gentlemen: Please send, without obligation, your latest literature describing the SW-227 Diathermy.

NAME _____

ADDRESS _____

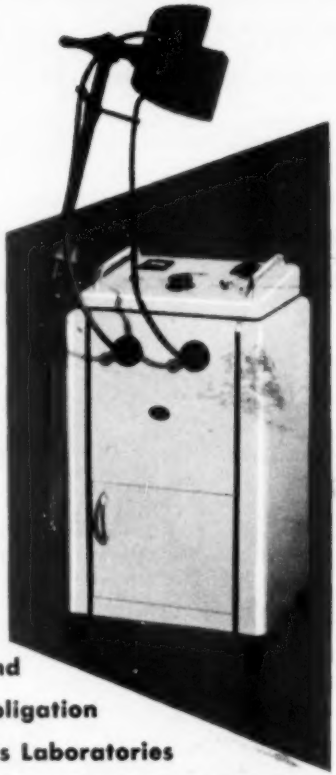
CITY-STATE _____

DO YOU WANT THE BEST

with economical cost?

APPARATUS FOR PHYSICAL MEDICINE

COMPLETE LINE



MEDITHERM — This is the quality line of short wave diathermy. Choice of three F. C. C. approved models of crystal controlled or non-crystal controlled units. The highest in performance at a reasonable price.

MEDIQUARTZ — The most complete line of ultra violet generators for the doctor or hospital. Body and localized irradiation, intracavity irradiation and air sterilization.

MEDI-SINE — An electronic low voltage wave generator with all fundamental currents, true "slow sinusoidal", automatic polarity reversal at each alternate impulse. Offers all practical therapeutic wave forms.

For full information — and free trial without obligation — write Dallons Laboratories for the name of your local dealer.

Dallons ENGINEERED

DALLONS LABORATORIES

5066 SANTA MONICA BOULEVARD • LOS ANGELES 27, CALIFORNIA

TEMPERATURES PRODUCED IN BONE MARROW, BONE AND ADJACENT TISSUES BY ULTRASONIC DIATHERMY

An Experimental Study *

PAUL A. NELSON, M.D.

Fellow in Physical Medicine and Rehabilitation, Mayo Foundation

J. F. HERRICK, Ph.D.

Division of Experimental Medicine, Mayo Foundation

and

FRANK H. KRUSEN, M.D.

Section on Physical Medicine and Rehabilitation, Mayo Clinic

ROCHESTER, MINN.

Interest has greatly increased during the past 10 years in the study of ultrasonics. Scientists in widely diverse fields have shown that important practical applications can be made of these high frequency acoustic vibrations which lie above the range of hearing.

With such widespread interest, it is not surprising that attempts have been made to apply ultrasonics for medical purposes. During recent years, apparently many physicians in central Europe have utilized ultrasonic radiation for therapeutic and diagnostic purposes in a startling variety of conditions, despite the fact that little is known concerning the physiologic effects of such radiation. In some of the published reports one receives the impression that such therapy has been used with little prudence. Because the enthusiastic claims of the proponents of "ultrasonotherapy" and "ultrasonoscopy" had been accorded rather considerable publicity, some investigation in this field was thought indicated. Consequently, steps were initiated about three years ago to make such an investigation.

One of the important and well known effects of ultrasonic irradiation which can never be disregarded is the production of heat.[1] Since studies concerning microwave diathermy had recently been carried out in our laboratory, it was decided that our first problem should be related to the thermal effect of ultrasonic radiation and that technics should be employed similar to those used with microwaves in order that a direct comparison could be made of these two forms of diathermy. It was hoped that such a study would answer the following questions: 1. What relative heating can be produced by ultrasonic radiation in living tissues, such as bone marrow, bone and muscle? 2. Might ultrasonic radiation prove to be a useful form of medical diathermy?

As early as 1932 Freundlich, Söllner and Rogowski[2] observed that a rise in

---

* Abridgment of thesis submitted by Dr. Nelson to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of Master of Science in Physical Medicine and Rehabilitation.

* Read at the Twenty-Eighth Annual Session of the American Congress of Physical Medicine, Boston, Aug. 31, 1950.

1. Wood, R.W.: Supersonics: the Science of Inaudible Sounds. Providence, R. I., Brown University, 1939. Wood, R. W., and Loomis, A. L.: The Physical and Biological Effects of High Frequency Sound Waves of Great Intensity, Philosophic Mag. 4:417 (Sept.) 1927. Richards, W. T.: Heating of Liquids by Absorption of Sound, and Its Relation to Energy of Intense High Frequency Sound Waves, Proc. Nat. Acad. Sc. 17:611 (Nov.) 1931. Dognon, A., and Biancani, E. & H.: Ultra-sons et biologie. Paris, Gauthier-Villars, 1937. Pohlman, R.: Über die Absorption des Ultraschalls im menschlichen Gewebe und ihre Abhängigkeit von der Frequenz, Physik. Ztschr. 40:159 (March 1) 1939. Söllner, Karl: Sonic and Ultrasonic Waves in Colloid Chemistry, in: Alexander, Jerome: Colloid Chemistry, Theoretical and Applied, New York, Reinhold Publishing Corporation, 1944, vol. 6, pp. 237-373. Heidemann, Egon: Grundlagen und Ergebnisse der Ultraschallforschung, Berlin, W. de Gruyter, 1939. Bergmann, Ludwig: Ultrasonics and Their Scientific and Technical Applications, New York, John Wiley & Sons, Inc., 1938. Bergmann, Ludwig: Der Ultraschall und seine Anwendung in Wissenschaft und Technik, Zürich, S. Hirzel Verlag, 1949.

2. Freundlich, H.; Söllner, K., and Rogowski, F.: Einige biologische Wirkungen von Ultraschallwellen, Klin. Wchnschr. 11:1512 (Sept. 3) 1932.

temperature of 10 to 15 degrees C. could be produced in the marrow of a chicken bone after only one minute of ultrasonic radiation. They also reported that this energy could be transmitted across the knee joint of a lamb. They expressed the belief that it might be possible to use such heating medically in certain places where it was not possible to use other types of diathermy. They recommended that the possibilities of ultrasonic radiation as a form of medical diathermy be further investigated.

Since 1932 there has been very little reported concerning the heating effects of ultrasonic radiation in living tissue. The report most pertinent to the present study is that of Pohlman, Parow-Souchon and Schlungbaum,[3] who carried out an experiment in 1948 in which they inserted thermocouples into the human gluteal muscle and measured temperature rises at various depths from 0.2 to 3.0 cm. after exposures to ultrasonic radiation for 20 seconds. The frequency used was 800 kilocycles per second, and the intensity was 4 watts per square centimeter. Ten seconds after termination of exposure, they obtained rises in temperature from about 3.4 to 1.5 degrees C. (in order of increasing depth).

Equipment

Two ultrasonic generators were used for this study. The smaller was an apparatus built for us by the Central Research Laboratories, of Red Wing, Minn. (fig. 1*a*), which

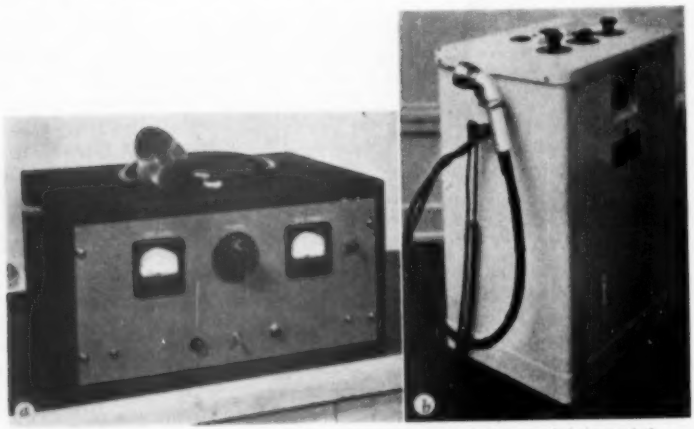


Fig. 1.—Ultrasonic generators used in experiments: (*a*) Central Research Laboratories' apparatus; (*b*) Siemens' sonostat.

produced a maximal output of 15 watts. The larger was the "sonostat" (fig. 1*b*), manufactured by Siemens-Reinniger Werke, of Erlangen, Germany, which delivered up to 60 watts of ultrasonic energy.

The principle of operation of these generators is similar and relatively simple. A high frequency radio oscillator is utilized which produces an alternating current of 800,000 cycles per second. This current is supplied to a piezo-electric crystal, which is usually quartz. Such a crystal has the property of undergoing a change in its physical dimensions when it is subjected to an electric field. When it is subjected to an alternating electric field, it sets up mechanical vibrations of the same frequency. These mechanical vibrations are maximal when the natural frequency of vibration of the crystal is the same as the frequency of the alternating electric field. This crystal is mounted in a grounded metal unit, which is called the applicator, or "sound head," in such a way that the mechanical vibrations (ultrasonic waves) are easily conducted through the metal diaphragm. Both of these ultrasonic generators are adequately shielded so that no electromagnetic radiations from the oscillator, transmission line or applicator were

3. Pohlman, R., Parow-Souchon, Eva, and Schlungbaum, H.: Über die Temperaturverteilung im lebenden menschlichen Organismus bei Ultraschalleinstrahlung, Klin. Wchnschr. **26**:277 (May 1) 1948.

detected in the ultrasonic field. A properly designed coaxial cable is required to transmit the high frequency alternating current from the oscillator to the crystal.

The measurement of intensity of ultrasonic radiation has been one of the greatest difficulties of working in this field. Through use of the Siemens' "dosimeter" (fig. 2), we were able to obtain a fairly accurate determination of the output of the generator. This instrument proved invaluable in our study.

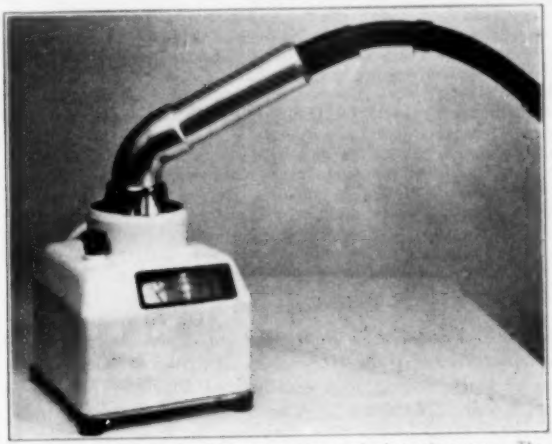


Fig. 2. — Instrument for determining output of ultrasonic energy. The applicator of the sonostat is inserted into the cup of the dosimeter. Readings are given in watts and are stated to be accurate to ± 5 per cent.

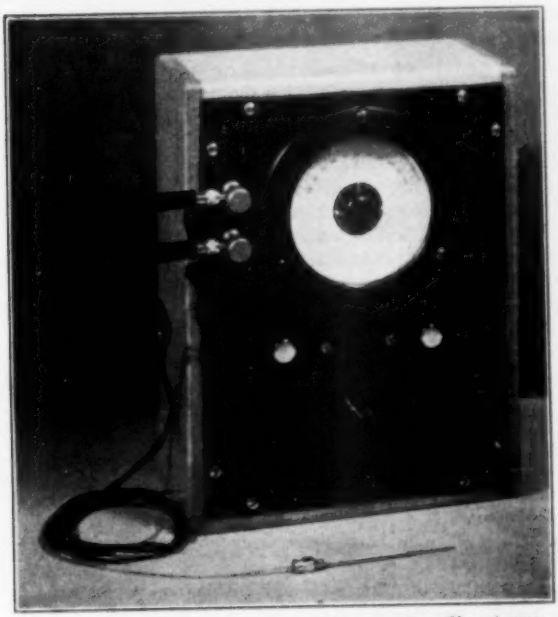


Fig. 3. — Thermistor used for measurement of temperature. The galvanometer is calibrated to read temperatures directly in degrees centigrade.

The measurement of temperatures in bone marrow, bone and muscle was accomplished by means of thermistors and a copper-constantan thermocouple. The thermistor (fig. 3) is a thermally sensitive resistor, a mixture of metallic oxides whose electrical resistance decreases as its temperature rises. Some thermistors are composed of oxides of nickel, cobalt and manganese; others are composed of oxides of copper, zinc, iron and uranium. The resistor forms one arm of a Wheatstone bridge, which is balanced for a given temperature; as the temperature of the resistor changes, the deflection of the galvanometer can be calibrated to permit reading temperature in degrees centigrade. The lead wires from the thermistor bead, which in our study measured only about 1 mm. in diameter, were enclosed in polythene tubing. Thermistors so designed provide an ideal method of measuring temperature in the medical laboratory from several points of view: They are highly accurate, they give readings within five seconds, they are rugged and they can be adapted for many types of uses within a wide range of temperatures. The other method of measurement of temperature, that is, use of the copper-constantan thermocouple, is so widely used that it requires no description here.

It was observed that accurate measurement of temperatures could not be made during exposure of tissues to ultrasonic radiation. Because of this fact, we allowed a period of 15 seconds to elapse between completion of ultrasonic radiation and our first recordings of temperature. In a preliminary series of experiments we demonstrated to our satisfaction that the same rises in temperature were observed whether thermistors remained in situ or were removed during ultrasonic irradiation.

Procedures and Results

Temperatures Produced in Bone Marrow, Bone Cortex and Muscle in the Hindlegs of Anesthetized Dogs. — A series of experiments was carried out upon the hindlegs of three fasting dogs anesthetized with intravenously administered pentobarbital sodium (Nembutal). A small incision was made over the anterior crest of the upper third of the tibia exposing the bone, at which site two holes were drilled with a dental burr, one through the cortex into the marrow and the other obliquely into the cortex for a distance of several millimeters (fig. 4*a*). Thermistors were then inserted into these holes and the incision closed around the lead wires. An additional thermistor was inserted through a 15 gauge needle into the anterior tibial muscle at the same level as the others.

The lateral surface of the hindleg was carefully centered over the applicator of the larger ultrasonic generator so that the thermistor beads would lie approximately near the center of the ultrasonic field. Readings of temperature were then made every five minutes until consecutive readings did not vary by more than 0.2 degree C.; this period was considered the control (fig. 4*b*). Just before irradiation was carried out, all surfaces in the path of the ultrasonic waves were moistened with detergent to assure good contact with the coupling medium, for which we found boiled distilled water to be most satisfactory. The temperature of the coupling medium was regulated to lie between 34 and 36 C. during irradiation so that gain or loss of heat by conduction would be kept at a minimum. During the period of radiation, which for this series was 1.5 minutes, the dog's leg was moved slowly back and forth over a distance of about 0.5 cm. in order to equalize the ultrasonic field as much as possible and to avoid standing waves. After irradiation was completed, readings of temperature were made at 15 seconds, 30 seconds, 1 minute, 2 minutes, 4 minutes and 9 minutes. At the conclusion of a series of such runs, roentgenograms were taken to show the exact positions of the thermistors (fig. 5*a* and *b*).

The average rises in temperature were calculated from readings obtained fifteen seconds after exposures to ultrasonic radiation of 1.5 minutes' duration. At an output of 5 watts, 13 separate runs were made, which resulted in average rises of 5.4 degrees C. in bone marrow, 5.9 degrees in bone cortex and 1.1 degrees in muscle. At an output of 10 watts, nine runs were made, which resulted in average rises of 10.3, 10.5 and 2.2 degrees C. in bone marrow, bone cortex and muscle, respectively.

Temperatures Produced in Bone Marrow, Bone Cortex and Muscle in the

Hindlegs of Trained Dogs. — A series of experiments was carried out to ascertain what rises in temperature might be obtained under similar conditions in dogs which had not received pentobarbital sodium. For this series three dogs were used which had been trained to lie quietly on the treatment table for extended periods. Preliminary to irradiation, thermistors had been inserted into the marrow and cortex of the tibia under aseptic conditions with the dog anesthetized. At this time the lead wires from the thermistors had been led subcutaneously to

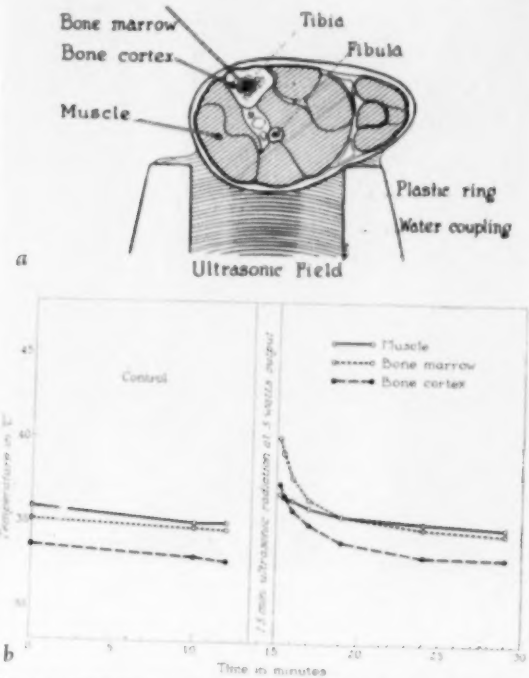


Fig. 6. — Temperatures produced in the hindleg of an anesthetized dog. (*a*) Cross section showing placement of thermistors in bone marrow, bone cortex and muscle. (*b*) Data obtained in a typical run in which ultrasonic radiation was given to the lateral surface of a dog's hindleg for 1.5 minutes' duration at an output of 6 watts.

the lateral midthigh region, where they had been brought through the skin (fig. 6*a*). On successive days after this surgical procedure, ultrasonic irradiation was carried out in a fashion quite similar to that employed in the other series except that no pentobarbital sodium was administered. Even though precautions were taken to prevent the dogs from disturbing the thermistors, it was not possible to keep the instruments in place and functioning properly for more than one week. To measure temperatures developed in the anterior tibial muscle, a needle thermocouple was utilized which was inserted to a depth of about 1 cm. Arrangements were made so that all temperatures could be recorded continuously on moving photographic paper. A typical photographic record obtained before, during and after medial application of ultrasonic radiation is shown in figure 6*b*. The smaller ultrasonic generator was used in this series of experiments.

The average rises in temperature calculated from readings obtained 15 seconds after exposures to ultrasonic radiation of five minutes' duration at 3 watts

Fig. 5. — Same case as in figure 4. (*a*) Anteroposterior and (*b*) lateral roentgenograms showing thermistors in place.

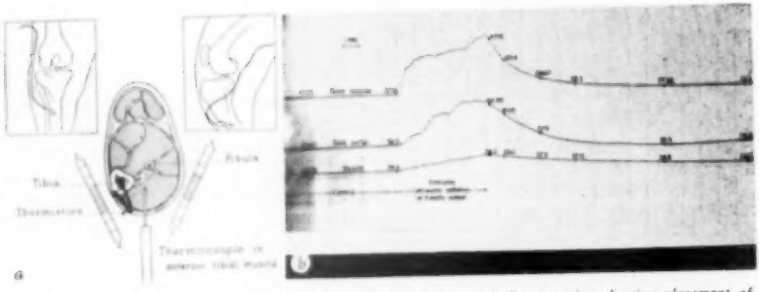


Fig. 6. — Temperatures produced in the hindleg of a trained dog. (*a*) Cross section showing placement of thermistors in bone marrow and bone cortex and of thermocouple in muscle with reference to the lateral (labeled "1") and the medial (labeled "2") application of ultrasonic radiation. The insets indicate the approximate position of the lead wires in the subcutaneous tissue. (*b*) Photographic record of temperatures obtained during a typical run in which the medial surface of the hindleg was exposed to five minutes of ultrasonic radiation at an output of 3 watts.

output are shown in the table. Because of certain technical difficulties that arose, it seemed best to list each of these dogs separately. In addition, the data were separated on the basis of whether ultrasonic radiation was applied to the medial or lateral surface of the hindleg. Conditions of technic were similar for radiation of dogs 1 and 3; however, in dog 1 a short circuit developed in the

Average Rise in Temperature in the Hindlegs of Trained Dogs *

Dog	Tissue	Medial Application: Runs	Medial Application: Average Rise in Temperature, C.	Lateral Application: Runs	Lateral Application: Average Rise in Temperature, C.
1	Bone marrow	3	9.8	1	11.0
	Bone cortex		—		—
	Muscle		2.3		2.2
2	Bone marrow	5	3.4	6	4.6
	Bone cortex		1.9		2.6
	Muscle		0.6		1.0
3	Bone marrow	4	9.8	2	9.8
	Bone cortex		8.8		7.5
	Muscle		1.5		3.1

* Data obtained 15 seconds after exposure for five minutes to ultrasonic radiation with an output of 3 watts.

thermistor in the bone cortex, and we were unable to obtain any readings. In dogs 1 and 3 a total of seven runs was carried out with ultrasonic radiation applied medially; the following average rises were obtained: 9.8 degrees C. in bone marrow, 8.8 degrees in bone cortex and 1.9 degrees in muscle. Unfortunately, in dog 2 the thermistors in the bone marrow and bone cortex were inadvertently placed about 1 cm. farther apart than in the other dogs; hence greater amplitude of movement of the leg had to be carried out in the attempt to equalize the ultrasonic field. This change in technic most probably accounted for the lower temperatures observed in this dog.

Comment and Summary

One of our primary purposes in carrying out this study of the heating effects of ultrasonic radiation was to compare the relative heating produced by this means in bone marrow, bone cortex and muscle with that produced by microwaves. Engel and co-workers,[4] using similar technic, exposed the hindlegs of a series of anesthetized dogs to microwave radiation from a hemispheric director at a distance of 2 inches (5.1 cm.) from the lateral surface of the leg just below the knee. At an output of 65 watts they obtained the following average rises after periods of exposure of 30 minutes: subcutaneous tissue 4.3, muscle 4.6, bone 3.8, marrow 3.0 and rectum 0.3 degrees C. In trained dogs they observed rises which were on the average about 1 degree lower than in the above series.

With ultrasonic radiation at an output of 5 watts, we were able to obtain the following average rises in the hindlegs of anesthetized dogs after exposures of only 1.5 minutes: muscle 1.1, bone cortex 5.9 and bone marrow 5.4 degrees C. At 10 watts, average rises about two times as great were recorded; namely, muscle 2.2, bone cortex 10.5 and bone marrow 10.3 degrees C. Because trained dogs did not tolerate ultrasonic radiation at an output of 5 watts, we reduced the output for this group to 3 watts and at the same time increased the duration of treatment to five minutes. In this way the total dosage (for our purposes watts times minutes) was the same as for the group of anesthetized dogs which received ultrasonic radiation at an output of 10 watts. The average rises observed in the trained dogs (with the exception of dog 2) were quite comparable

4. Engel, J. P.; Herrick, J. F.; Wakim, K. G.; Grindlay, J. H., and Krusen, F. H.: The Effect of Microwaves on Bone and Bone Marrow and on Adjacent Tissues, Arch. Phys. Med. 31:483 (July) 1950.

to those of this latter group of anesthetized dogs. We were not able to detect any significant change in the rectal temperature of the dogs which we exposed to ultrasonic radiation.

It is difficult to compare the effects of two sources of energy such as microwaves and ultrasonic waves, which are as dissimilar as light and sound. No conclusion may be drawn by comparison of the output of the respective generators as to their efficiency in heating the various tissues. Even when a careful attempt is made to duplicate technic of application, other factors enter in which necessitate certain changes. For example, in an ultrasonic field of the frequency at which we worked, phenomena of standing waves become more prominent than in a microwave field. This is so because the ultrasonic wavelength which we employed is of the order of magnitude of one tenth of the length of the microwaves in muscles. In order to eliminate these phenomena as much as possible, we introduced the technic of moving the dog's leg in a "back and forth" motion in the ultrasonic field. Also by this means we attempted to produce a more uniform field.

The following statements appear justified concerning the heating effects of microwave and ultrasonic radiations upon tissues in the dog: 1. With microwave radiation, highest temperatures were observed in muscle; with ultrasonic radiation significantly higher temperatures were observed in bone cortex and bone marrow than in muscle. 2. Under the conditions of our experiments and those of Engel and co-workers, we were able to obtain after only 1.5 minutes of ultrasonic irradiation, at an output of 5 watts, rises in temperature of bone cortex and bone marrow that were slightly greater than those obtained after 30 minutes of microwave radiation at an output of 65 watts. 3. No observable gross damage to superficial tissues was noted following either microwave or ultrasonic radiation in these two series of experiments.

Our study has shown that considerable rises in temperature of bone cortex and bone marrow occur during ultrasonic radiation. This rise in temperature must be attributed to absorption of ultrasonic energy. From a survey of the literature and on the basis of certain other experiments which we have carried out, it is evident that many factors are involved in determining the amount of absorption that occurs, including (1) the physical properties of bone cortex and bone marrow, such as density, elasticity, temperature, structural interfaces presented by bone crystals, blood vessels, blood cells and dissolved gases and lipid content; (2) physical position of the ultrasonic field with reference to the surfaces of tissue and bone, and (3) characteristics of the ultrasonic source, in particular its frequency and intensity.

Because there are so many conditions influencing the amount of absorption that occurs and because it has been the common experience among investigators working in the field of ultrasonics to obtain occasionally widely divergent results, many competent men have become discouraged concerning its applicability in medicine. Throughout our experiments we ordinarily had no serious difficulty in obtaining results on consecutive runs in which there was a variance of not more than 1 or 2 degrees. However, on a few occasions we obtained what we considered a widely divergent reading for no apparent reason so far as we could tell. These occurrences were quite frustrating.

Our major purpose in carrying out this study was to decide whether or not ultrasonic radiation might prove to be a useful form of medical diathermy. The suggestion for such use of ultrasonics was first made by Freundlich, Söllner and Rogowski[2] in 1932. However, since then there have been surprisingly few studies concerning this aspect of ultrasonics. Perhaps the principal reason for the lack of research concerning the thermal effects of such radiation has been the difficulty in measuring intensity, a problem which has occupied the best minds in

the field for the past thirty years and for which even yet there is no completely satisfactory solution.

As we have shown, ultrasonic radiation heats living tissue effectively, but there are a number of important limitations. In the first place, under the conditions of our study it is an extremely localized form of heating. Secondly, except at quite low intensities, which are nevertheless effective in causing appreciable heating, ultrasonic radiation is a most uncomfortable source of diathermy, especially over superficial bones, where it causes a typical deep burning pain. Lastly, ultrasonic radiation is occasionally quite unpredictable with regard to the amount of absorption (consequently heating) that occurs owing to a number of complex factors; considerable allowance should be made for this variability.

On the other hand, ultrasonic radiation causes selective heating of bone cortex and bone marrow which so far as we know is not possessed by any other form of medical diathermy. In addition, it causes appreciable heating of muscle to a considerable depth and also of subcutaneous tissue. Because of this selective heating, ultrasonic radiation must be used with caution in the proximity of bones because the temperatures produced in bone cortex and bone marrow may rise to dangerous levels within a very few minutes.

If ultrasonic radiation proves in the future to be a useful form of medical diathermy, it would seem most likely that its use will be limited to treatment of small circumscribed areas. Since bone cortex and bone marrow are heated so readily in an ultrasonic field, it would seem logical to suggest that a convenient point of departure in a study of the therapeutic effect of ultrasonic diathermy would be its effect upon certain forms of chronic osteomyelitis resistant to therapy with antibiotics. In such cases the possible danger in damage to healthy tissue by this radiation would be outweighed by the possibility that the bacteria in the infected part might be killed or rendered less harmful through such intense heating.

Conclusions

1. Ultrasonic radiation can produce rather sharply localized heating in living tissues.
2. Ultrasonic radiation causes selective heating of bone cortex and bone marrow as does no other source of energy used thus far for medical diathermy.
3. If ultrasonic diathermy is ever to be administered clinically, a rather wide margin of safety with regard to dosage is necessary because of unexpected variations that not infrequently arise.

Acknowledgments are made to Dr. J. H. Grindlay for surgical assistance in placement of thermistors in the series of trained dogs, to Dr. E. J. Baldes for his aid in helping us to obtain ultrasonic equipment, to Dr. K. G. Wakim for his suggestions with regard to procedures utilized and to Mr. Earl A. Glarborg for his technical assistance.

The discussion of this article will appear in a later issue of the ARCHIVES.

PHYSICAL MEDICINE IN THE TREATMENT OF SHOULDER DISABILITIES *

K. G. HANSSON, M.D.

Associate Professor, Cornell University Medical College;

Director, Physical Medicine, Hospital for Special Surgery and New York Hospital

NEW YORK

Shoulder disabilities are very common in medical practice, especially among ambulatory patients, both clinic and private. They account for a high percentage of the patients referred to the physical medicine department in both general hospitals and in orthopedic hospitals. There is often a tendency to classify all the disabilities as painful shoulders, bursitis, arthritis, myositis and neuritis. The correct diagnosis is just as important in shoulder disability as in disabilities in other parts of the body. The nonspecific diagnosis is too often followed by nonspecific treatment. We will try to differentiate among a few of the commoner pathologic states about the shoulder and to correlate the treatment accordingly.

Anatomy

Because of its position, the shoulder is exposed to a great deal of trauma. The structure of the shoulder is intended for mobility, and this has been obtained by sacrifice of a certain amount of stability. The skeleton consists of a hatrack arrangement of the clavicle, which has to support the weight of the scapula and the upper extremity. In order to allow a maximum amount of motion, the glenoid fossa is small and the shoulder joint is protected by the acromial process. The muscles can be divided into one group of large muscles, represented by the deltoid above, the pectoralis major in front and the latissimus dorsi in the back. The other group consists of smaller muscles, such as the supraspinatus and infraspinatus and teres minor, which externally rotate the humerus, and the subscapularis and teres major, which internally rotate the humerus. The position of the glenoid fossa is determined by the scapula, which, in turn, can be moved toward the spine by the trapezius and the rhomboids and away from the spine by the anterior serratus. It can also be moved clockwise or counterclockwise. The capsule of the shoulder joint differs somewhat from other capsules because of the folding of the inferior part when the arm is hanging in vertical position. The large blood vessels and brachial nerves also pass in close proximity to the joint. Because of the great motility of the shoulder joint, several bursae are found, the most important one being the subdeltoid bursa, which has extensions under the acromion and forward under the coracoid process.

Phylogenetic studies of the shoulder will show that movements away from the body, such as abduction and extension, are relatively younger functions. The nerve supply to the abductors and extensors comes from the posterior nerve roots, which are branches of the main nerve trunks, which seem to continue into the ventral branch, which supplies muscles producing movements toward the body. We therefore believe that abductors and extensors are weaker than their antagonists, the adductors and flexors. The newly acquired movements — that is, abduction, extension, internal and

* This paper is part of a panel-symposium on the "Shoulder," held at the Spring Session of the Eastern Section of the American Congress of Physical Medicine, Washington, D. C., April 29, 1950.

external rotation — are the first ones lost in disabilities about the shoulders. These muscles are more commonly involved in paralysis, we believe. This is an example of specific morbidity that is always high in muscles producing movements away from the body.

Gravity is another factor that puts the deltoid of the shoulder at great disadvantage when compared with its antagonists. It is also a mechanical disadvantage when we analyze the leverage in the shoulder, especially the relation between the origin and insertion of the deltoid and the fulcrum in the head of the humerus, which three points all fall in one straight line.

There are many ways of discussing disabilities of the shoulder. For the sake of simplicity, I am going to divide the disabilities according to basic symptoms: (*a*) when pain is the cardinal symptom; (*b*) when there is weakness of the shoulder, and (*c*) where the main factor is stiffness of the joint.

Pain

The symptom of pain is the most prominent one in peritendonitis, radiculitis, and scalenus anticus syndrome.

I. Peritendonitis. — This is often called subdeltoid bursitis and may appear in acute form very suddenly or in a chronic form, in which discomfort comes on gradually and may end up in the acute form. The etiology of peritendonitis is best described by Codman. He believes that the rotator tendons of the shoulder and the musculocutaneous cuff are subject to slight trauma, usually between the head of the humerus and the acromion process. These injuries are followed by degeneration of the tissues. These breakdowns in the tissues are sometimes followed by an accumulation of calcium which may break into the subdeltoid bursa and set up a foreign body reaction. Our opinion of peritendonitis about the shoulder has lately been challenged, as for instance, by De Palma's pathological reports. He analyzed 93 postmortem examinations of shoulder of patients who had had no symptoms while alive. He found that the majority of these shoulders showed tear of one or more of the rotator tendons.

The clinical symptoms are severe pain about the shoulder, acute tenderness of the bursa and limitation of abduction, external and internal rotation of the shoulder. I believe that all can agree that these symptoms result from an acute inflammation, and treatment should be the same as for an acute inflammation anywhere else. The simplest, most effective treatment is that of an ice bag to the affected shoulder, a sling for the arm and some sedative. When the pain subsides, which is usually on about the fifth day, some limitation of motion persists and we add exercise to regain normal function. The best type of exercises are the relaxed swing exercises with the body held in 90 degree forward flexion. These exercises originated with Codman and can be started at a very early stage. I have modified these exercises by having the patient lying on his side on the table with head and shoulders outside the end of the table with head supported by a footstool and a pillow. In this position the arm will hang in 90 degrees abduction and can swing in two planes and also in circumduction. External rotation is also important.

II. Radiculitis. — We often encounter patients with pain about the shoulder, in whom the pain is also present in the neck and upper extremity. This distribution of pain usually originates in the cervical portion of the spine. It may be due to osteoarthritis or postural defect or trauma which will irritate the nerve roots and distribute the pain along the cervical segments. When the third cervical segment is involved it will produce pain in the occipital region. Involvement of the fourth segment produces pain posteriorly

along the medial border of the scapula. The fifth and sixth segments when involved will produce pain about the shoulder itself; involvement of the seventh produces pain along the dorsal surface of the hand in the half next to the thumb, and involvement of the eighth produces pain in the dorsal surface of the hand in the lateral half and most of the posterior surface of the forearm. Irritation of the first thoracic segment will produce pain over the medial surface of the forearm. The patients with these symptoms are usually in the middle age or old age group. It is very common in desk workers or persons with poor postural curves in the cervical region which later become the seat of osteoarthritis.

Because of the location of the pain and distribution of the cervical segments, a difference in the diagnosis from peritendonitis is easy to make. This is a definite nerve pain or radiculitis produced by mechanical pressure at the root of the nerve. If this is kept in mind the therapeutics are evident. Best results are obtained by traction applied to the cervical spine, preferably with countertraction on the shoulder maintained for short periods of time and, when possible, repeated several times a day. This traction is supplemented by active exercise for promotion of stretching or elongation of the cervical spine and hyperextension. In very severe cases, a Thomas collar is sometimes added.

III. Scalenus Anticus Syndrome. — The third clinical entity of pain about the shoulder may occur in various degrees: (1) neurological complaints of pain in the neck, over the scapula, under the clavicle, down the shoulder and upper extremity and into the hand along the radial, ulnar and medial nerves; (2) vascular complaints with diminished pulse and blood pressure on the affected side; (3) vasomotor symptoms of ischemia or temperature changes, or (4) tenderness on pressure over the scalenus anticus muscle on the brachial plexus.

All these symptoms are related to the anatomy of the neck and the superior outlet of the thorax. This outlet is completely surrounded by rigid body structures. Behind is the cervical-thoracic spine; laterally, the first rib, and in front, the sternum. The lower fibers of the brachial plexus, the autonomic nerve supply to the arm and the subclavian artery and vein must pass over the rigid outlet. These structures form the apex of an arch as they pass over the first rib. This rigid arch is compared to a pulley over which the subclavian vessels and the nerve fibers are more or less stretched.

Several conditions which might increase the tension and pressure on these structures can be visualized: 1. The first rib may be placed high. 2. An extra cervical rib may raise the pulley. 3. Spastic scalenus anticus muscles may lift the thoracic cage. 4. There may be an increased traction from within the thoracic cage which may occur in pneumothorax. 5. There may be increased traction by the scapula and the upper extremity. These symptoms are usually found in the third or fourth decades of life. They may be brought on by occupational stress, including housework, but the real cause is probably congenital predisposition. However, on all this is superimposed a loss of muscular tonus as an exciting cause.

Treatment: 1. Rest and support: Bed rest with arm elevated gives relief to both circulatory symptoms and nerve irritation. A sling is sometimes sufficient, a figure 8 bandage to hold the shoulders back and up, and in severe cases, an airplane splint may be necessary.

2. Exercises: (*a*) Exercises of position. Any position that will relieve the pressure on the brachial plexus and the subclavian vessels over the bony rim over the scalenus anticus and muscles may be of value. The back stroke

of the crawl and the neck firm position are useful. In severe circulatory involvement with edema, we make use of vasomotor exercises similar to those used in the treatment of endarteritis of the lower extremities. (*b*) Active exercises. They may be divided into local exercises for the shoulder girdle and general postural exercises.

3. Radiation: Infrared as well as shortwave diathermy will give temporary relief to muscle spasm of the scalenus anticus and relieve irritation of the brachial plexus.

4. In cases where the conservative treatment does not give relief, the only recourse is surgery; but probably more than 95 per cent of the patients with these symptoms are relieved by conservative treatment.

Weakness from Paralysis Found in Poliomyelitis, Serratus Paralysis and Erb's Palsy

I. Poliomyelitis. — Poliomyelitis may be followed by residual weakness of either upper or lower extremities. While weakness of the lower extremities may interfere with locomotion, weakness of the upper extremities curtails the patient's effort to help himself in his daily tasks of living. It, therefore, becomes very important that we take all possible steps to prevent such paralysis and also give all possible care in minimizing the residual after-effects of poliomyelitis in the upper extremities. In recent years we have overemphasized therapeutics and compromised on long-established laws of prevention. It, therefore, seems rational to repeat the old established formula for treating peripheral nerve lesions: 1. Weakened muscles should be held in neutral positions. The muscles involved must always be supported in such a way that overstretching is impossible. 2. Gravity must be eliminated. 3. Adequate blood supply must be maintained.

In analyzing muscle action we must differentiate between concentric and eccentric muscles. These muscles act together as antagonists, and their action depends on muscle tonus for smooth performance. The concentric and eccentric muscles are also synergistic in their action. Overstretching of muscles, in addition to producing atrophy, may also produce fibrosis.

The constant presence of gravity must be remembered when weak muscles are present. Not only is this important in standing but also in the sitting and lying positions. We should also remember that overstretching of the muscles will elongate the blood vessels and thereby diminish the blood supply to the muscles.

Experience gained over many years of practice would indicate that muscle paralysis about the shoulder is best treated by (1) support of the weakened muscle, (2) electrical stimulation to weakened muscles and (3), when possible, active exercises such as weightlifting, which is probably the best exercise for producing muscle power.

II. Serratus Magnus Paralysis. — The shoulder joint movements are also influenced by the movements of the scapula and the stability of the scapula. An example of instability of the scapula affecting shoulder joint movements is paralysis of the serratus magnus. This muscle is innervated by the long thoracic nerve, and paralysis of this nerve will produce a winging of the scapula and inability to elevate the arm completely. The functions of the serratus magnus are these: It serves as a stabilizing force, fixing the scapula when the pectoralis minor is used in deep breathing. 2. It counteracts the pull of the trapezius, rhomboids and levator scapula. 3. It serves as an active force in bringing the scapula forward, thereby increasing the reach of the hand.

The cause may be trauma or residual paralysis from poliomyelitis, or the condition may be idiopathic, similar to Bell's palsy. The treatment involves three principles: (1) immobilization by means of brace or leather cuff which holds the scapula in place and prevents rotation of the scapula, (2) electrical stimulation of the serratus magnus muscle and (3) exercises. These are two types: (*a*) exercises which act to contract the serratus magnus, as exemplified by the patient's sitting at the side of the table with the arm resting on the surface of the table and the arm sliding forward, and (*b*) exercise concerned with the supporting muscles of the scapula, i. e., the trapezius muscle and the rhomboids.

With these measures the patient with a paralyzed serratus magnus can look forward to complete recovery, but the treatment may take six months to a year.

III. Erb's Palsy. — Erb's palsy, or birth paralysis, is defined as a paralysis, usually partial, the result of injury during birth. Three types are recognized: the upper arm (Erb-Duchenne) type, involving the fifth and sixth cervical roots; the lower arm (Klumpke) type, involving the eighth cervical and first thoracic roots, and the total arm types, involving all roots from the fifth cervical to the first thoracic. The cause is probably an injury directly of the nerve roots or cords of the brachial plexus, but there is some evidence to support the view that the lesion is one of injury to the shoulder joint and secondary injury to the nerves or the nerve plexuses. Clinically the lesion appears as a flaccid paralysis of the upper extremity. Later deformity develops as a result of contractures of unopposed muscles. Remembering the distribution of the nerves of the brachial plexus, we note that the upper roots are involved first and the lower ones progressively less severely, in order of the severity of the trauma. But usually the majority of the lesions are those involving the upper roots, the Erb-Duchenne type involving the muscle groups ennervated by the fifth and sixth nerve roots, and the muscles most commonly involved are the deltoid, the supraspinatus and infraspinatus, the biceps brachialis, the brachioradialis and supinator brevis. The lower arm type shows involvement primarily of the muscles supplied by the eighth cervical and first thoracic nerve roots and involves the intrinsic muscles of the hands and ulnar forearm with the frequent exception of the abductor pollicis and opponens pollicis, which receive ennervation from the fifth and sixth cervical roots.

Treatment: Treatment should be instituted as early as possible and consist first of splinting the arm in the position of rest of the affected muscles, followed by passive exercises to the contracted muscles and active exercises to the weakened muscles. This is followed by gentle massage. If there is evidence of improvement, it should be maintained for a period of years and in many cases complete restoration of function will result.

Disabilities About the Shoulders Characterized Mainly by Stiffness

There may be other symptoms, such as pain, but disabilities of this group usually begins by a stiffness and, if untreated, may go on to ankylosis.

I. Arthritis of the Shoulder Joint. — We will first consider arthritis of the shoulder joint. The commonest form is probably rheumatoid arthritis, which may be either acute or chronic. One will find very much the same symptoms as you find in arthritis of other joints of the body. It is usually only one part of the complete picture of rheumatoid arthritis. All motions of the shoulder joint are limited and atrophy very soon appears. It may be periarticular when roentgenograms are negative, or the disease may go on to

the destruction of the articular cartilage. This will, of course, show up in the roentgenograms. The diagnosis is usually established by the fact that other joints are involved. The treatment should be the same as treatment for rheumatoid arthritis in other parts of the body. The new drug cortisone and similar drugs may benefit this disability of the shoulder in the near future. Owing to the fact that in the arthritic shoulder stiffness of the joint and atrophy of the muscle develop early, our therapeutics should be directed to adequate blood supply to the shoulder by applications of heat, the maintenance of tone of the muscle by means of massage and prevention of ankylosis by means of shoulder joint exercises similar to Codman's exercises. If, in spite of everything, the shoulder joint muscles do become ankylosed, a great deal can be done for the patient by teaching him substitution movements by means of the shoulder girdle exercises.

II. Frozen Shoulder. — This name is given to stiff shoulder that often develops from painful shoulder, elbow or hand. Any painful condition of the upper extremity is inducive to immobilization of the shoulder in adduction, and the shoulder has the tendency to become frozen in this position. Unconsciously substitution will develop, whereby the movement in the shoulder joint is replaced by shoulder girdle movements. This is a retrogression to the quadriped function of the shoulder. The shoulder joint is held rigid and the shoulder girdle moves. This type of joint function will set up a reflex pattern very different from our free-moving shoulder joint.

Treatment: Anything that might promote the unfreezing of the shoulder joint may be rational, but we believe that the most important factor is the retraining of the patient away from the substitution movement of the shoulder girdle and back to the stimulation of the muscles that control the function of the shoulder joint itself. The patient should be made actively conscious of the action of the deltoid, the subscapularis and teres major which control the internal rotation, and the supraspinatus, infraspinatus and teres minor, which control the external rotation.

III. Fractures About the Shoulder. — The last disability of the shoulder that we will discuss is that of fractures about the shoulder. All fractures about the shoulder may produce limitation of the shoulder movement. This stiffness is usually caused by the immobilization. The common occurrence of this complication led Lucas Champonniere to minimize the time of immobilization and to emphasize the importance of early motion in these fractures. In order to simplify our point, we will discuss only the impacted fracture of the surgical neck of the humerus. This fracture is very common in middle age and in the old age group, and the old treatment with the Velpeau dressing always led to loss of motion in the shoulder joint. The latest principle in treatment of this fracture is to give the patient a sling and start early motion. The shortcomings of this treatment is the fact that carrying the arm in the sling produces internal rotation of the humerus. By keeping the arm in internal rotation, external rotation is soon lost, and, if external rotation is lost, complete abduction is impossible. In other words, complete abduction in the shoulder is possible only with the humerus in external rotation. Without external rotation, lateral elevation is limited to 90 degrees.

The early exercises for the impacted fracture of the surgical neck are, therefore, based on obtaining external rotation. 1. With patient lying on his back, elbows toward the side and forearms held vertically, the exercise consists of turning the forearms outward. 2. The patient is on his back with shoulder abducted to the maximum and is encouraged to reach the bed stand above the head. 3. The patient is still on his back with hands and neck firm

and tries to touch the bed with his elbows. 4. The exercises should be continued until full abduction and elevation is obtained, which is accomplished when patient can reach the left ear with the right hand over the head. 5. With patient standing, stooping forward with the body at right angles to the leg and steadying himself with the normal arm on the table, he swings the fractured arm in the anterior-posterior plane, lateral planes and circumduction, both clockwise and counterclockwise.

Summary

The commoner shoulder disabilities may be considered in three groups:

(*a*) When pain is the cardinal symptom;

(*b*) When the main difficulty is weakness of the shoulder;

(*c*) When the main factor is stiffness of the joint.

Pain. — I. In the first group, the pain is due to peritendonitis, which can be treated conservatively by use of an ice bag and sling in the acute stage or the application of heat and exercise in the chronic stage.

II. Radiculitis is a nerve pain that may reach from the neck down to the hand. Symptoms of pain in the occipital region over the scapula, shoulder, forearm or hand usually indicate different levels of root pressure. Poor posture or osteoarthritis, or a combination of the two, is usually the cause.

III. The scalenus anticus syndrome includes pain about the shoulder and upper extremity following the radial, ulnar and medial nerves. There are often vascular complaints and vasomotor symptoms, and these usually indicate pressure of the brachial vessels or brachial plexus passing over the bony ridge or the thorax. Treatment consists in relieving this pressure.

Weakness. — I. Poliomyelitis is often followed by residual weakness of the deltoid muscle. It is most important to support the weak muscle and maintain the tone and blood supply of the same muscle.

II. Serratus magnus paralysis of the long thoracic nerve will produce a typical winged shoulder. Treatment here, too, is support of the weakened muscle and proper exercise to regain muscular strength.

III. Erb's palsy, clinically, produces flaccid paralysis of the upper extremity, but later deformity develops as a result of contractures of unopposed muscles. With this in view, splintage and conservative treatment over a long period of time are important.

Stiffness. — I. Rheumatoid arthritis of the shoulder joint should be treated the same as arthritis in any other part of the body.

II. Frozen shoulder may follow any pain of the upper extremity and often results in retrogression of function when shoulder joint movement is substituted by shoulder girdle movement. Treatment should be based on retraining the patient in the proper reflex pattern.

III. Of fractures about the shoulder, impacted fractures of the cervical neck can be placed under treatment in the second day. However, it is most important to emphasize the external rotation which is often lost by the position of the arm in a sling. Without external rotation, complete abduction of the shoulder is impossible.

If more specific diagnosis of shoulder disabilities is obtained, more specific treatment will follow, with better results for the patient.

ORTHOPEDIC ASPECTS OF SHOULDER DISABILITIES

CARL BERG, M.D.

Assistant Clinical Professor of Orthopedic Surgery,
George Washington University School of Medicine

WASHINGTON, D. C.

The time allowed for this discussion is too brief to permit a description of details of treatment of the painful shoulder. I shall, rather, outline causes of shoulder pain, for without accurate diagnosis intelligent treatment is impossible

Pain in the upper extremity, or brachialgia, is very common, frequently incapacitating and often misdiagnosed. Anything which produces pressure anywhere along the nerve pathways supplying the upper extremity can produce pain.

It must not be forgotten that visceral disease is not infrequently responsible. This fact emphasizes the necessity for taking an accurate history, especially with respect to those factors which produce the pain, aggravate it or relieve it. For example, if motions of the neck are limited and painful or associated with muscle spasm it is reasonable to suspect that there is something wrong with the cervical spine or its associated structures. If motion in the shoulder joint is limited or painful, one may assume that this joint or its accessories is abnormal.

If pain is caused by exertion which does not involve the cervicobrachial mechanisms, they may be eliminated as the principal cause of symptoms. Thus the pain of angina pectoris, which may be present in the neck, the chest, the shoulder or the arm, is caused by bodily exertion and relieved by total rest. This is well exemplified by a case which I observed not long ago.

The patient had recurrent attacks of pain in the neck and shoulder. Roentgenograms revealed degenerative arthritis of the cervical spine. That could cause pain of this type and distribution, but careful questioning revealed that the occurrence of symptoms followed a very definite pattern. The patient noticed that every morning as he left his house and walked hurriedly for several blocks the pain occurred. A short rest relieved it. At the time of my examination no real pain was produced by motions of the neck, although there was some limitation of motion because of degenerative arthritis, which in this case was merely incidental. Motions in the shoulders were complete and entirely painless.

Another case in which neck and shoulder pain were the presenting complaints remained a diagnostic mystery for some time. The symptoms were not related to the use of these parts. Physical examination revealed a definite Horner syndrome. Roentgenograms showed a superior sulcus, or Pancoast tumor. Horner's syndrome should always be sought in any examination for brachialgia.

Let us trace the nerve pathways from the cerebral cortex to the periphery of the structures of the upper extremity and consider the common causes of pressure. They may be categorically divided into those within the skull, within the spinal cord, within the spinal foreamens, along the nerve roots and along the peripheral nerves. The type and distribution of sensory involvement gives a clue to where the pressure occurs.

* This paper is part of a panel-symposium on the "Shoulder," held at the Spring Session of the Eastern Section of the American Congress of Physical Medicine, Washington, D. C., April 29, 1950.

Skull

Lesions within the cranium may cause widespread involvement since vital structures are concentrated there.

Spinal Cord

There is dissociation of sensory changes, since only specialized fibers may be damaged; syringomyelia is a good example. The lesion is in the central part of the cord and affects pathways carrying pain and temperature sensations. The simple expedient of adequate neurologic examination can determine this diagnosis. A friend of mine in the country solved a diagnostic mystery when, in the course of a routine examination, he found the patient unable to discriminate between a test tube containing hot water and one containing cold. The diagnosis of syringomyelia had been missed on previous investigations.

Extra medullary tumors, such as neurofibroma, may be responsible.

Nerve Roots

Narrowing of the intervertebral foramens is a relatively frequent cause of symptoms. Nature has been generous in providing ample space for the nerve roots in the cervical region, but bony proliferation may be so marked that the root is severely compromised. The ability of the nerve root to adapt itself to slowly progressive narrowing of the foramen is often remarkable, the root assuming a ribbon-like form without any of its elements being destroyed.

I recently saw an exhibit of several cervical spines which had been removed from cadavers. They all showed severe degenerative arthritic changes with narrowing and distortion of the intervertebral foramens. Although symptoms had been present in life they were not incapacitating. The nerve roots had altered their contours to conform to the foramens without actual apparent destruction of any of their elements. The adaptation was comparable to that which occurs in the spinal cord in cases of tuberculosis of the spine with severe kyphosis.

Degenerative changes at the level of the fifth and sixth cervical vertebrae are almost physiological as middle life is reached. Evidences of degenerative arthritis are frequently confined to this one level. Next in frequency is involvement of the space between the fifth and sixth cervical vertebrae or a combination of the spaces between the fifth and sixth and the sixth and seventh. Concomitant with the bony narrowing of the foramens are proliferative changes in the soft tissues. It is probably this component which is relieved by head traction. Proper roentgenograms are essential in evaluating the cervical spine. This includes oblique views which properly depict the foramens.

A loss of the normal cervical lordosis points to irritation with spasm of the cervical muscles. Undue pressure on the cervical nerves may be produced at various points along their course from the spine to the shoulder joint. Cervical ribs, the scalenus anterior muscle, the costoclavicular space and the pectoralis minor muscle may be responsible. The cervical rib and scalene muscle, because of their intimate relationship to the nerves and vessels supplying the upper extremity, can cause not only neurological but vascular disturbances as well. The pectoralis minor muscle overlies the nerves in intimate contact and by contracture may produce undue pressure.

The effect of these factors may be enhanced by postural changes in which the anterior cervical muscles, adductors and internal rotators of the humerus become progressively shortened, resulting in stretching and weakening of the scapular elevators, particularly the trapezius, allowing the scapula to descend with resulting increased stretching of the nerves.

It is at the time of life when these postural changes become definite that symptoms ordinarily begin.

Embryologically the scapula develops at a high level and during childhood and youth there is gradual descent. If progressive postural deterioration occurs, this downward migration of the scapula is accentuated.

Although the anterior scalene muscle may produce symptoms it is usually only because it is altered by postural changes. It will usually release its vicious pressure when these are corrected, making surgical division of the muscle unnecessary. Section may sometimes be required, but these cases must be infrequent.

The coracopectoralis minor syndrome appears to be a definite entity. It is characterized by pain around the shoulder, often radiating down the arm. There is definite tenderness to pressure over the attachment of the pectoralis minor to the coracoid. Upon pressure, radiating pain into the arm and hand may be produced. Relief is gained by wearing a sling while symptoms are acute, by avoidance of heavy clothing, carrying or lifting and by a shoulder brace and correction of postural tensions.

Probably the commonest cause of pain in the neck and shoulders is on a postural basis. The patient is approaching or has arrived at middle age and is usually engaged in a sedentary pursuit. His discomfort is often definite upon arising in the morning but is severest after sitting for long periods with the head bent forward over a bench or desk, and especially after driving a car for a long distance.

There is a feeling of tension in the muscles of the back of the neck, with a sense of fatigue and aching which extends over the occiput and into the shoulder girdle muscles, predominantly on one side. Usually there is a fairly well localized area of more acute pain situated near the superovertebral angle of the scapula. This is very tender to pressure; sustained pressure may cause pain to extend down the arm.

The mechanism of these changes develops in the following way: As the shoulders continue to sag, the adductors and internal rotators of the humerus become increasingly shortened. The head moves forward so that the cervical spine becomes extended. The anterior cervical muscles contract. The scalene and pectoralis minor muscles take part in this change. The scapula elevators become stretched and weakened, allowing the scapulas to descend. This produces the typical round-shouldered chin forward position. Basically, the remedy lies in developing the scapula elevators. This is accomplished by exercises which the patient performs himself. It cannot be effectively accomplished until the tight anterior structures have been stretched. Heat to the contracted muscles and passive and active stretching make it possible to develop the trapezii by active exercise. A shoulder support and stretching of the neck by traction are often valuable adjuncts. If pain is acute, a collar is of great help. Attention to a proper sleeping position is important. A firm mattress to prevent sagging and a bolster type of pillow under the neck with just enough support under the head to maintain it in neutral alinement are indicated. Total postural correction is necessary for satisfactory results.

Cervical Disk

In cases of severe and intractable pain in the neck, shoulder or upper extremity the possibility of a ruptured intervertebral disk should be considered. It is possible that this condition is present more frequently than is realized. In these days, low back pain with sciatica is considered to be due to a ruptured lumbar disk until proved otherwise. A knowledge of the effects of the lumbar herniated disk is common; a similar awareness in regard to the cervical disk is not.

As in the lumbar area, there may not be in the beginning any evidence of definite nerve root pressure. There may be only aching in the neck and shoulders. Pain may radiate into the arm. It is common for pain to be present in the upper arm, with only paresthesias in the hand. Accentuation of symptoms on coughing, sneezing and straining is characteristic.

A small laterally placed disk causes pressure on a nerve root; one larger and more centrally placed produces pressure on the spinal cord. Prognosis in cases of root pressure is good after the obstruction has been removed. The prospects of complete recovery are not so good after pressure on the cord has been relieved.

Disk protrusions are most common at the spaces between the fifth and sixth and seventh cervical vertebrae. It is at these levels that wear and tear on the cervical spine is greatest, the same area where degenerative arthritic changes most commonly take place. The sixth and seventh nerve roots are therefore the ones most often affected. The sixth root governs the biceps reflex; the seventh root, the triceps reflex. Sensation to the thumb is carried by root 6; to the index finger, by root 7. Localization of the herniated disk is usually possible by careful neurological examination. Since there are other conditions which simulate the herniated disk, myelography may be necessary to settle the diagnosis.

Spurling describes a sign which he feels is diagnostic. This is performed by bending the patient's head toward the shoulder on the affected side. Forceful downward pressure is then exerted upon the head. The pain should be produced or accentuated by this maneuver. Traction on the neck should give some relief.

Lesions About the Shoulder Joint

The head of the humerus and capsule of the shoulder joint are intimately surrounded by a system of muscles and tendinous structures called the musculotendinous cuff. This is composed of the subscapularis, supraspinatus, infraspinatus and teres minor. The deltoid muscle covers the shoulder joint. Between this muscle above and the tendinous cuff below lies the subacromial bursa. Immediately under the floor of the bursa is the supraspinatus tendon. Passing from the superior portion of the labrum of the glenoid through the joint and down through the intertubercular sulcus of the humerus is the tendon of the long head of the biceps muscle.

The musculotendinous cuff normally undergoes progressive degenerative changes with increasing age. This deterioration is sometimes manifest as early as the fourth decade. The changes are as inevitable as wrinkles and gray hair. This evolution was strikingly shown in a demonstration of a series of shoulder joints from autopsy material covering all periods from childhood to old age.

The supraspinatus tendon is subject to severe and persistant strain. As it degenerates, calcium is frequently formed in the tendon substance. The calcium deposit may be fluid and unincapsulated or may be granular and

inspissated and bound into the tendon fibers. Its contact with the floor of the bursa irritates the bursal lining, causing pain. The pain may be spontaneously relieved if the calcium ruptures through the floor of the bursa. This release of tension produces relief of pain in the same way as does incision of an abscess. Needling the deposit may accomplish its release in the same way.

If the material is mature and bound into the substance of the tendon, actual incision into the tendon with curettage of the granular deposit may be necessary. It is well to emphasize the importance of proper roentgen technic in evaluating the calcium deposit. Views must be taken in various rotations.

Inflammation of the subacromial bursa alone may not be very frequent. There are extremely acute cases in which this condition may be present. These attacks occur suddenly, result in severe pain and usually subside fairly promptly with no residual loss of motion.

The common form of disease diagnosed as subacromial bursitis probably involves the musculotendinous cuff quite extensively. The onset is more gradual, with persistence of symptoms and with progressive loss of shoulder joint motion, abduction and rotations being most affected. In many cases all shoulder joint motion seems to be lost. This is the so-called frozen shoulder. The musculotendinous cuff is contracted and tightly hugs the humeral head. Progressive physical therapy with manipulations may gradually release adhesions and restore motion. Although this point is controversial, I believe that when properly done manipulation under anesthesia to release adhesions saves much time in convalescence.

Occasionally the subacromial bursa becomes chronically thickened and crowds under the acromion upon abduction of the humerus. Excision of the bursa is then necessary. Removal of the lateral portion of the acromion probably improves the result, but the necessity for this has recently been questioned. I have been impressed with its value.

Biceps tendinitus is a frequently unrecognized cause of shoulder pain. It is believed that many cases treated as adhesive capsulitis or subacromial bursitis without satisfactory progress are refractory because of persistent tendosynovitis of the tendon of the long head of the biceps.

The biceps tendon passes through the intertubercular groove of the humerus. This forms a tunnel with the transverse humerus ligament as a roof. A prolongation of the synovial membrane of the shoulder joint is extended over the tendon to the inferior border of the transverse ligament. The tendon has an excursion of 1½ inches in the groove. Very little motion occurs with the shoulder joint fixed while the elbow is carried through its range of motion. The notable excursion is produced by motions of the shoulder joint. Adhesions within the tunnel limit shoulder joint motion. Irritation of the sheath causes pain.

Exploration of the sheath may reveal almost complete fixation of the tendon. Resection of the free portion of the tendon above the tunnel with absolute fixation of the tendon within the intertubercular groove relieves the symptoms.

In some cases the intertubercular sulcus is abnormally shallow. This permits the tendon to dislocate upon certain motions of the shoulder. The dislocation is associated with a snap and with pain. Tenderness to pressure over the sulcus suggests bicipital tenosynovitis. Yergason's sign is considered to be diagnostic. This is performed by flexing the elbow to a right angle. Supination of the forearm is resisted. Pain is produced at the intertubercular sulcus.

Rupture of the Rotator Cuff

Since Codman's original researches there has been sustained interest and much study devoted to injuries of the rotator cuff of the shoulders.

Function of the supraspinatus has been in question. It was commonly believed to be responsible for the initiation of abduction. It is now generally agreed that it stabilizes the head of the humerus in the glenoid, providing a proper fulcrum for abduction and elevation. Its function has been compared to the effect of putting a foot against the base of a ladder to permit its elevation without the base slipping.

Good function is often possible with tears of moderate degree. In later life there are many fairly extensive tears which do not interfere seriously with function. Complete tears interfere with function so seriously that repair is advisable, especially if the patient is not too old.

The complete tear involves the supraspinatus, infraspinatus and teres minor muscles. The subscapularis may even be involved. In time the edge of the cuff which has separated from the humerus thickens and retracts under the acromion. The history of an acute tear develops as follows:

The patient reports a severe sudden pain in the shoulder which occurs while lifting or raising the arm. After the momentary twinge there is a period of relative comfort for a few hours with more gradual return of pain. Active elevation and abduction are impossible. The attempt is associated with pain over the head of the humerus. There is severe pain on palpation at the tendon insertion; a hiatus may be felt.

In the beginning, it is impossible to determine whether this loss of function is due to pain or to lack of muscle power. Injection of procaine (Novocain) hydrochloride will make these motions possible if pain is the only factor.

As a rule, immediate operation is not indicated. A period of observation and conservative treatment will often restore function, making surgery unnecessary. Unsatisfactory progress under conservative treatment, with no sign of return of essential function, is an indication for operative repair. An attempt to define the extent of the tear and its location may be made preoperatively. By rotating the humerus so that each element in the cuff is brought into play separately as abduction is attempted, some information may be gained as to which element is torn.

SUCTION SOCKET PROSTHESIS FOR THE ABOVE KNEE AMPUTEE *

JOHN H. ALDES, M.D., F.A.C.S.

VAN NUYS, CALIF.

The suction socket prosthesis is an artificial limb which is held on by a moderate suction created in the closed socket and is so fabricated that it conforms to the anatomic features of the stump, thereby allowing the muscles of the stump to control all physiologic movements of the limb. The only apparent difference between the conventional above-the-knee prosthesis and the suction socket leg is that the latter eliminates all suspension harness, pelvic belt and hip control (fig. 1).

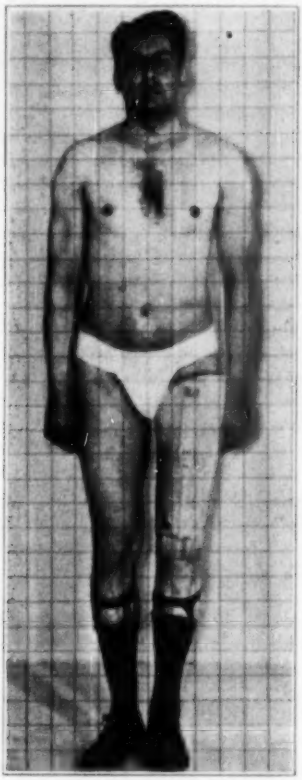


Fig. 1. — Suction socket prosthesis for the above-the-knee amputee showing absence of all suspension harness, pelvic belt and hip control.

* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 7, 1948.

* Orthopedic Surgical Section, Birmingham Veterans Administration Hospital.

* Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are a result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

Records of the United States Patent Office show that the suction socket is not new. In 1863 a patent was issued embodying the same fundamental principles as are used today in this type of prosthesis.[1] A review of the medical literature reveals sporadic use of the suction socket prosthesis until 1944, when Kirschner and Dittert, of Düsseldorf, Germany, reported the use of this limb in 39 cases.[2]

With the great demand for more satisfactory artificial limbs since World War II, the Surgeon General's Office, in conjunction with the Veterans Administration and the National Research Council, instituted a program in 1946 to determine the usability of this type of prosthesis. Clinics were set up throughout the United States, with the orthopedic surgeons, various university engineer groups and limb fitters, coordinating their findings. The present report is based upon the results and experience of the clinic conducted in the Veterans Administration's Los Angeles Regional Office,[3] where the suction socket prosthesis was used in 49 cases selected from 330 service connected above-the-knee amputees. Of the patients chosen, 89 per cent were between the ages of 21 and 39, and 11 per cent were between 30 and 50. The selection of these patients was based upon an acceptable medical examination, proper psychologic condition and suitable above-the-knee stump from an anatomic and physiologic basis. The psychologic aspect in all amputees is important, especially with the suction socket wearer. In order to evaluate the usability of the suction socket, the veterans selected to wear this prosthetic device must have the right mental attitude and emotional qualities.

Factors such as deep or adherent scars above and below the brim of the socket; adhesions between the skin, muscles and bone; neuromas, spurs at the end of the stump; short stumps; vascular diseases; capillary fragility; associated injuries of the opposite leg; extremely heavy amputees, and arthritic condition involving the lower back, opposite hip, knee and ankle, were originally considered contraindications, but at the present time under proper medical supervision they are not a factor. Currently the three important contraindications are active osteomyelitis, severe dermatalogic conditions and extremely short stumps.[2a]

The Stump

We have found in fitting and training the amputee for the use of this prosthesis that the stump which is about 10 inches below the greater trochanter, cylindrical and well formed, with no excessive padding over the distal end of the bone, is the most satisfactory.[4] In stumps shorter than this, the adductor power is limited and the muscular control of the stump becomes proportionately less. Stumps shorter than the middle third of the thigh have a tendency toward flexion and adduction deformities,[5] thus making alinement and fitting of the suction socket more difficult. Stumps with less than 5 inches of femur measured from the greater trochanter cannot be fitted with this prosthetic device, as then it is almost impossible to make a seal that will hold suction.

1. University of California, Prosthetic Devices Research Project, The Committee on Artificial Limbs, National Research Council: The Suction Socket Above-Knee Artificial Leg. A revised report. April, 1948.
2. (a) University of California, Prosthetic Devices Research Project, The Advisory Committee on Artificial Limbs, National Research Council: The Suction Socket Above-Knee Artificial Leg. Third Edition. April, 1949. (b) Allbredge, Rufus H.: History of the Suction Socket, National Suction Socket Training Program, November, 1947.
3. This clinic was organized by me June 23, 1945, under the supervision of Dr. Paul J. McMaster, Senior Orthopedic Consultant, Veterans Administration, and Mr. Herbert F. Roseff, Prosthetic Representative, Veterans Administration.
4. Kirk, N. T.: Amputations. Lewis D.: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1942.
5. Thomas, Atha, and Haddon, C. C.: Amputation Prostheses, Philadelphia, J. B. Lippincott Company, 1945.

The anatomic structures of the stump, which are important in fitting a suction socket, are the gluteus maximum, the adductors and the quadriceps muscles, the ischial tuberosity, the greater trochanter, the femoral triangle and the sciatic nerve. Muscle tone and strength must be adequate to obtain normal physiologic action for the control of the limb. The ischial tuberosity is important as a weight-bearing factor resting on the ischial seat of the socket. It does not vary with stump swelling or contraction, thus maintaining a constant pelvic level. The greater trochanter determines the lateral border of the socket. The bony prominence just behind the trochanter aids in stabilizing the leg against rotation and lateral movement and serves as a seal against air leakage. The femoral triangle, with its vessels located superficially, is vital in the circulation of the stump. Pressure over this area causes restriction in blood flow resulting in edema and vascular changes in the distal end of the stump.[6] Care must be exercised when the sciatic nerve is involved, since excessive tightness in the fit of the posterior brim of the socket will cause irritation to the nerve, with resulting paresthesia (fig. 2).

Socket Construction

Willow wood has been found to meet the primary requirements in material for the suction socket. Since changes in the stump, such as muscle elongation and hypertrophy, take place in the first few months of wearing the prosthesis, wood, which is easy to shape, allows the necessary alterations. Later, when the diameter of the stump remains constant, the socket may be made of plastic material, which is preferable because it is more flexible, is less affected by perspiration and withstands cleansing.

Although a single pattern may be used as a basis for all sockets at the level of the ischial tuberosity, the wood socket must be carved and shaped to fit the individual patient to his specific modifications. The basic measurement of the perimeter, taken through the crotch and in the gluteal crease, determines the pattern size of the upper level of the socket. The wood which forms the ischial seat lies inside this perimeter[7] (fig. 3).

The success of the suction socket is based upon the anatomic fit, thus establishing as near as possible physiologic movement of the stump. Variations in the shape of the stump depend upon the patient's muscular development, subcutaneous fat and bony skeleton (fig. 4).

The important dimensions to be obtained from the patient's stump are the length from the adductor longus muscle through the medial side to the ischial tuberosity and the distance from the medial side to the lateral side. With the above two, and the perimeter measurement, a pattern for the socket may be outlined.[2a]

In shaping the socket to meet each patient's anatomic contour, the medial side is recessed to receive the adductor longus, magnus and gracilis muscles. The height of the medial side should not be less than ½ inch below the ischial seat, and if a medial or adductor roll is present the socket is recessed further to allow for the excess tissue.[7]

The anterior area of the socket is kept tight, but not tight enough to produce pressure over the femoral triangle, with resulting impairment to circulation in the stump.[6] To hold suction in this region, especially with shorter tapering stumps, a slight undercut can be made just below the superior brim. The height and slope of the anterior area are in accordance with the needs of the patient.[7]

6. Inman, Verne T.: The Classical Picture of Edema in Relationship to the Problems of the Suction Socket, National Suction Socket Training Course, University of California, November, 1947.
7. Footnotes 1 and 2.

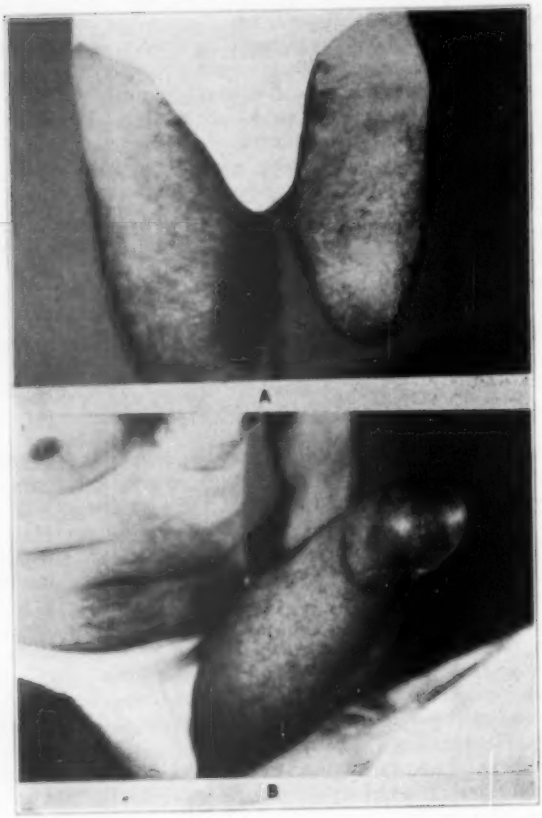


Fig. 2. — *A*, adequate 10 inch stump, cylindrical and well formed. *B*, distal end of stump showing edema and vascular changes secondary to pressure over the femoral triangle.

The lateral side should be fit slightly higher than the ischial seat level. The highest point on the superior brim is ahead of the greater trochanter with a slope across the front to the medial side. It should never be high enough to interfere with hip flexion or adduction. The protuberance constructed in the socket, which makes contact just back of the greater trochanter, is important as a stabilizer in walking, maintaining the position of the ischium on the ischial seat, as an aid to resistance of leg rotation, and an aid to holding suction in the sitting position. As mentioned in the shaping of the medial side, undercuts are also made here to comply with the patient's stump.[5]

The posterior part of the socket is extremely important in the ischial bearing socket. Earlier in the program the ischial seat was made large, but that was found to be one of the difficulties preventing comfortable wearing of the socket. The seat should be adequate but not so wide that it causes a jabbing or burning sensation, discomfort when sitting or increased pressure after prolonged standing.[6] It should meet the anatomic requirements of the

5. National Suction Socket Training Program. Answers to questions on construction and use of the suction socket for the above-knee stumps, November, 1947, paragraph 6.

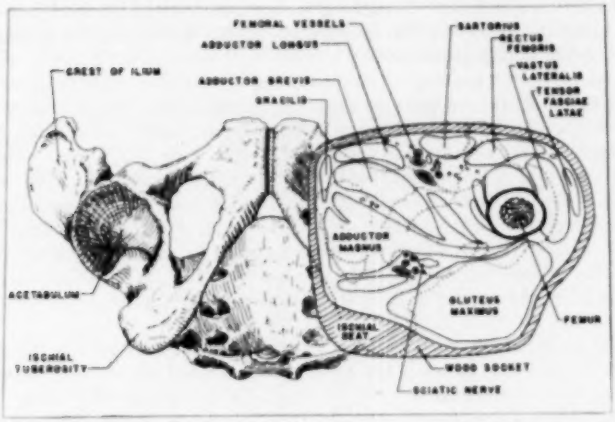


Fig. 3. — Cross section of thigh at the ischial seat, showing relation of the anatomic structures to the suction socket. (Composite drawing of two anatomic cross sections of pelvis and thigh at ischial tuberosity, reproduced from preliminary report, September, 1947, and third edition, 1949, University of California, The Prosthetic Devices Research Project, The Committee on Artificial Limbs, National Research Council: The Suction Socket Above-Knee Artificial Leg.)

patient so that the slipping of the ischial tuberosity, either to the inside or outside of the seat, will not occur. At the present time it has been learned that the shaping of the bearing surface to slope slightly toward the inside of the socket has proved more comfortable for the wearer. It has also been found that the gluteal muscles can carry a considerable amount of body weight, and, therefore, the relief of the socket in that area should be modified to accomplish this feature. If the socket is too tight in the gluteal area, it

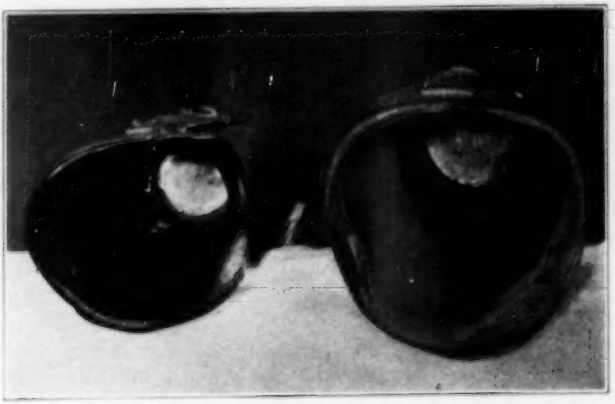


Fig. 4. — Variations in the perimeter of the suction socket due to the shape of the individual stump.

may cause discomfort to the adductor group. In some cases the ischial seat must be eliminated entirely for the wearer who has a prominent gluteal maximum muscle. Soft back sockets, which have been used on conventional prosthesis, can be utilized in such cases.[2a]

The amount of space at the end of the socket is not important with regard

to the suction obtained. Usually 2 inches below the end of the stump provides sufficient space for the installation of the valve and the ultimate elongation of the stump muscles.[2a]

Although end bearing is recommended in suction sockets to relieve the total weight on the ischium it has been found in this clinic that if the majority of weight bearing is through the ischium better results are obtained.

Much experimental work has been done with the valve. The simple plug type valve with manual release, the breather valve and the automatic expulsion type have been used. At present the automatic expulsion type[9] or two-way valve appears to be superior to other kinds. The valve opening should be placed in a position where there is no possibility that the distal end of the stump will contact the inner face of the valve. Locating the valve anteriorly on the medial side and below the stump has proved most satisfactory.[10]

The prosthesis is held on by a negative pressure or suction of about 1½ pounds per square inch. This pressure is created in the closed socket by the weight of the leg as it is lifted from the ground in the swing phase of walking. A positive pressure of about ½ pound is noted during the weight bearing phase[10] (fig. 5).

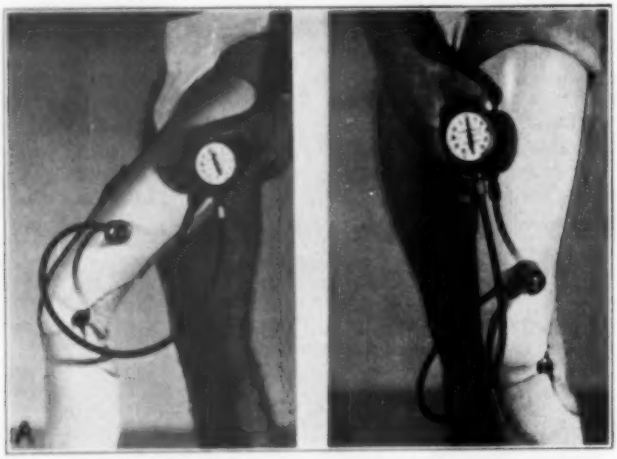


Fig. 5. — *A*, pressure gauge attached to the automatic expulsion type valve, showing a negative pressure of 1½ pounds per square inch when the leg is in the swing phase of walking. *B*, pressure gauge showing a positive pressure of ½ pound per square inch occurring during the weight bearing phase of walking.

The socket is made to fit snugly, shaped to the anatomic contour of the stump, but not to restrict the muscular movement or circulation of the stump. When the socket is properly fitted, there should be no motion between the skin and the inside wall of the socket. The femur will then move within the soft tissue of the stump.[2a]

Rehabilitation

In the selection of the group for the initial use of suction socket, one of the factors that had to be considered was the muscle tone not only of the stump but of the opposite leg and the entire body as well. Each applicant

9. National Suction Socket Training Course: Suction Socket Valves, November, 1948.
10. Footnotes 10 and 2a.

had an examination by the physical therapist. Gait, posture and muscle strength were important if we were to evaluate the wearer accurately. Very few of the group chosen could be classified as good walkers. Postures were

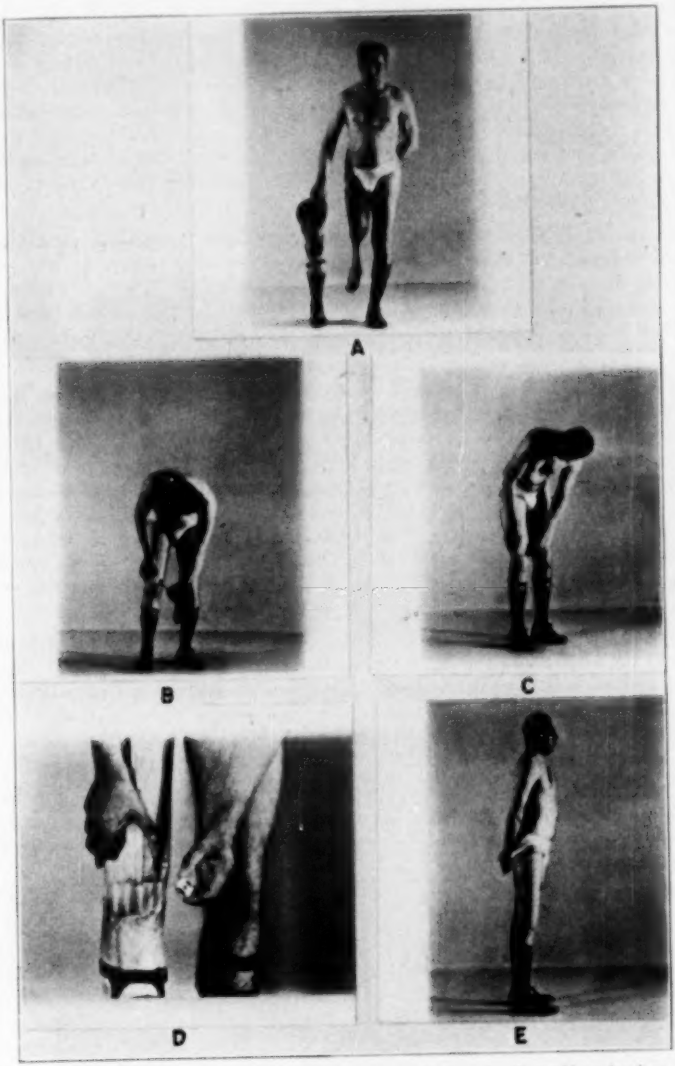


Fig. 6. — Method of putting on the suction socket prosthesis. *A*, silk stocking placed on stump; *B*, removal of stocking through valve opening; *C*, replacement of automatic expulsion valve; *D*, close-up of automatic expulsion valve before insertion into valve opening; *E*, side view of a suction socket prosthesis on an above-the-knee amputee.

poor, and in about 50 per cent of the patients muscle tone of the stump was only fair.

In reviewing the case histories, we found that the majority of veterans did not have an adequate physical rehabilitation program following their final surgical procedure or after their first conventional prosthesis was obtained. The lapse of time since leaving the hospital averaged four years with no reconditioning during that period. This meant a rehabilitation program prior to the fitting of the suction socket. Bad walking habits had to be corrected, and stump muscle tone had to be improved. Many of our failures in the preliminary suction socket schools were due to lack of continuous rehabilitation in teaching the amputee good posture and proper gait. The best results in our clinics were not only with amputees who had a stump of adequate length and good muscle tone but also with those whom we were able to put through a rehabilitation program following the fitting of their suction socket prothesis.[11]

Shrinking of the stump by stump therapy, and increasing muscle tone by heavy resistance exercises,[12] have always been big factors in obtaining adequate stumps. For the suction socket amputee, such reconditioning is most essential. With our group we have found that the stumps that had not been adequately prepared by wrapping and reconditioning were difficult to fit.

The stump, owing to natural muscle growth from manipulation of the prosthesis, increases in diameter after the suction socket has been worn a few months. The two factors in stump growth are subcutaneous fat and muscle. In the initial period of wearing the prosthesis, the fat decreases rapidly in proportion to muscle hypertrophy, which results in shrinkage of the stump. This physiologic change necessitates the insertion of a liner in the socket. Soon thereafter, hypertrophy takes place and the liner is removed. To eliminate this preliminary shrinkage, adequate stump therapy prior to fitting the socket and for the first few months of wearing the prosthesis has been necessary.

Heavy resistance exercises have proved most beneficial in strengthening not only the stump and the opposite leg but the entire body as well.[12] Many of our suction socket applicants who had worn a conventional prosthesis for several years had hip contractures, poor quadriceps tone in both thighs, weakness of the opposite knee and general flabbiness in the abdominal and lower spinal muscles (figs. 7 and 8).

Replacement of the conventional leg with a suction socket prosthesis usually causes imbalance in gait. To overcome this imbalance, the patients are placed on crutches and are given walking exercises to be done before mirrors (fig. 9).

After the suction socket has been fitted, walking instructions should be given gradually. The suction socket amputee must be constantly checked during the initial phase of wearing and then at regular monthly intervals for the next year. For the amputee to derive the maximum benefits from the many advantages of the suction socket, correction of alinement and fitting must be made from observation of the patient in activities such as standing, sitting and going up and down stairs. The prosthesis may fit perfectly in one phase, only to be unsatisfactory in another. Tightness, burning sensation, paresthesias and circulatory disturbances must be constantly watched for when the amputee is being checked in the various ambulatory stages.

11. Blair, Harry C., and Morris, Harry D.: Amputations of Major Types, Western J. Surg. 56:105 (Feb.) 1948.
12. DeLorme, Thomas L.: Restoration of Muscle Power by Heavy-Resistance Exercises, J. Bone & Joint Surg. 27:645 (Oct.) 1945.

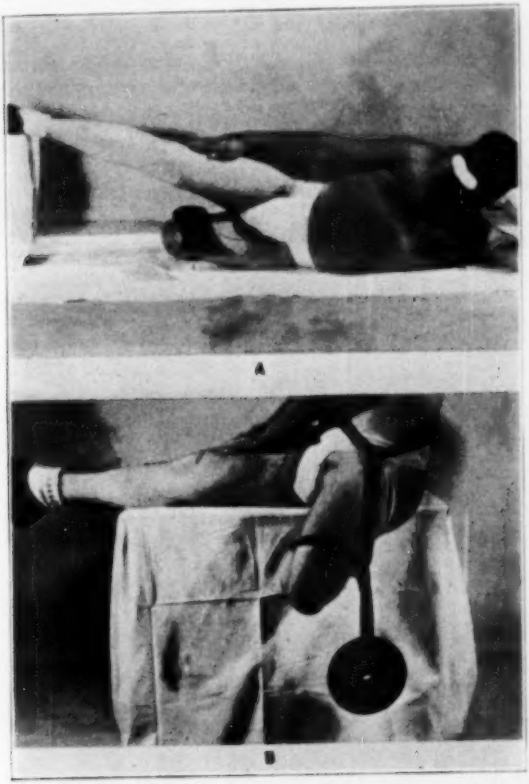


Fig. 7. — Heavy resistance exercises. *A*, adduction of the above-the-knee stump; *B*, flexion exercises of the involved stump.

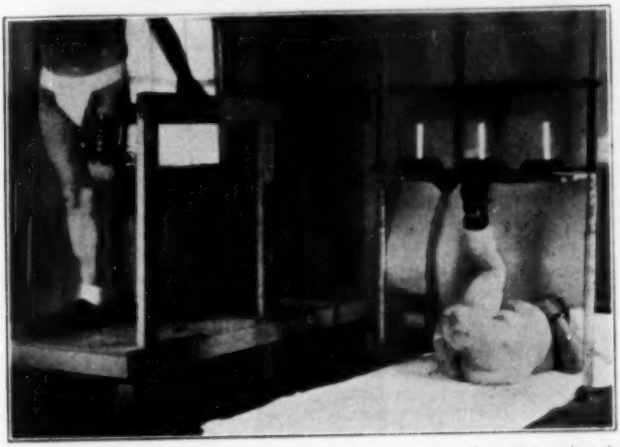


Figure 8. — Heavy resistance exercise using a pulley apparatus for active motion of stump in functional position and the leg press for the normal leg.

Failures and Corrections

The suction socket is still in the experimental stage; therefore several errors in construction and fitting have been discovered. With experience has come the knewledge of how to correct these failures, the major ones of which are the following[6]:

1. Edema of the distal end of the stump can be corrected by relieving the pressure over the femoral triangle, relieving tightness in the mid-third and distal end of the socket, and reducing the prolonged negative pressnre to within 1½ pounds per square inch.

Fig. 9. — Balance exercise using crutches before mirrors.

2. Discoloration at the distal end of the stump can be corrected by relieving pressure over the femoral triangle as indicated in the preceding paragraph and correcting the abnormal capillary fragility.

3. Loss of the artificial limb owing to pressure leakage can be corrected by proper fitting of the upper brim of the socket along the muscle channels and greater trochanteric area, checking the valve opening and correcting any errors in the mechanism of the automatic expulsion valve.

4. Burning and jabbing sensations in the region of the ischial seat can be corrected by (*a*) reducing the width of the seat; (*b*) sloping it forward; (*c*) increasing the wood protuberance just back of the greater trochanter; (*d*) preventing skin from stretching over the ischial seat in walking or sitting; (*e*) increasing the gluteal maximum chan-

nel, and (f) eliminating the entire ischial seat in the patient with an extensive gluteal muscle mass.

5. Tightness along the adductor channel can be corrected by lowering the brim in that area and further undercutting the adductor and gluteal channels.

6. Perspiration can in some cases be corrected by placing silica crystal gel in a small cloth bag at the distal end of the socket and relieving the tightness in the mid-third of the socket.

7. Skin irritations can be relieved in most cases by checking the excessive perspiration, smoothing the inside finish of the socket and frequently cleaning the inside of the socket and the stump.

8. Insecurity of the prosthesis resulting in poor gait can be corrected by proper alinement, accurate fitting, and proper reconditioning of the stump.

Summary

1. A suction socket prosthesis can be successfully used in about 75 per cent of the above-the-knee amputees if the stump is at least 10 inches in length below the greater trochanter, is well formed and has good muscle tone.

2. The best results with this prosthetic device are obtained with patients between the ages of 21 and 40.

3. The majority of failures with the suction socket are due to poor fitting.

4. Physical rehabilitation of the amputee is a vital step toward the success of the suction socket.

5. The advantage of the suction socket over the conventional prosthesis is that it allows a greater freedom of movement, better control of the leg, since it feels like a normal part of the body, and lack of need for pelvic belts, hip controls and suspenders.

6. The muscles of the stump hypertrophy and increase their physiologic action with the wearing of a well fitting suction socket.

7. Without the wholehearted cooperation of the patient, limb fitter, corrective therapist and orthopedic surgeon in following through with frequent check-ups during the first year of wear, the suction socket cannot be a success.

I am indebted to Mr. Philip A. West, Supervisor of Corrective Therapy, Amputee Program, and Mr. Tom Masterson and Mr. E. A. Dagner, of the Medical Photographic department, Birmingham Veterans Administration Hospital, for their aid in preparing the photographs and slides used in this paper.

Discussion on Papers of Drs. Bagby, Yamshon, et al., and Aldes *

Dr. Harold Dinken (Denver): Dr. Bagby's paper, concerning his program, was extremely interesting for several reasons. I think that an institution of that type, devoted to the over-all problem of rehabilitation of a tuberculous patient is in very excellent position to do something about the problem. Unfortunately, in many civilian institutions the care of the tuberculous patient is not so well coordinated between the internist and the physiatrist. I think the Veterans Administration can make a very concrete contribution on this point. Many internists are still very reluctant to investigate the possibilities of controlled activity in tuberculosis, and the mere word "exercise" stirs up a great deal of resentment.

One of the important problems that I hope Dr. Bagby will investigate in the future, is the role of personality in recurrence of tuberculous lesions. During the war several hundred patients were analyzed from the standpoint of personality structure and the influence of personality on future recurrence, and of this group it was found that two predominant personality types were involved. One was the very dependent patient, who was glad to accept hospitalization, who accepted all therapy — in fact, was eager for it. The other type was the problem patient with tuberculosis, who was the extrovert, the independent person, who was never dependent upon any one, and certainly would not accept dependence in tuberculosis, who was not willing to accept hospitalization and was not willing to accept therapy, as suggested. I was particularly interested in the low A. W. O. L. rate at Dr. Bagby's institution.

* The article by Dr. Bagby appeared in the July, 1950, issue of the ARCHIVES; the article by Dr. Yamshon, et al., appeared in the Nov., 1949, issue.

I think one of the important factors to be mentioned here is the fact that we need a clinical test for early activity and recurrence. If we wait for the usual findings of x-ray interpretation or sputum analysis or even the recurrence of clinical fever, we have waited too long. The important point is to get the tuberculous patient when he leaves the rehabilitation program and pick him up before these findings become positive.

Dr. Yamshon's paper was extremely interesting, and I believe it adds to our approach to the problem of the hemiplegic patient.

Dr. Licht stated that this may not be of practical importance in the retraining of hemiplegic patients. I am not quite sure whether he is right or not. The future certainly will decide that.

The first time I ever noticed the occurrence of this reflex in the hemiplegic patient was fairly recently and quite by chance. We had a young doctor who had a cerebral accident, due to trauma, and during his exercise program of movement reeducation it was noted that he always turned his head to the involved side. At first it was felt that he was simply trying to cooperate and closely observe what was being done with his upper extremity, but, as it turned out on further questioning, he said that he noticed that when he turned his head to that side his range of motion and his strength were better.

Since then we have noted several other reflexes, such as the increased ability to extend the hand at the wrist with simultaneous flexion at the shoulder and inversion of the foot with hip and knee flexion and others.

I am not sure what the eventual role of the tonic neck reflex and other reflexes in training will be. Certainly under test conditions the patient will have increased functional capacity. Whether this can carry over into daily activities, I am not sure.

Dr. Aldes' paper was very well done. He certainly stated the problem of suction prosthesis very well. I simply wish to affirm Dr. Aldes' observation that the three important factors in the use of this new device are important psychological preparation of the patient for the use of the socket, good fit with constant rechecking to change the socket as needed and, most important of all perhaps, the supervision from the standpoint of muscle retraining and gait retraining.

AN EVALUATION OF VARIOUS METHODS OF HEATING VAGINAL AND ADJACENT TISSUES *

R. N. MILLER, M.D.
STEVEN M. HORVATH, Ph.D.
C. DAY, M.D.
F. X. SWEENEY, M.D.
A. RUBIN, M.D.
H. MELLETTE, B.S.
F. SMITH, R.P.T.
and
B. K. HUTT, R.P.T.

PHILADELPHIA

Most gynecologists believe that heat is of value in the treatment of pelvic infection. The amount of heat necessary to produce required results does not appear to be clearly defined. Clinically it is considered that heat sufficient to induce only mild changes in the local temperature is effective. However, there are investigators who insist that best results are obtained with very high local temperatures. Ignoring for the moment the relative virtues of these two opposing concepts, it is worth while to consider the question as to the absolute ability of the various modalities being employed to raise the temperature of the vagina and adjacent tissues. Values as high as, or even higher than, 114 F. have been claimed by some investigators. And yet, in many instances, the justification for such claims is not apparent, and they are not substantiated by the data or the methods of collection of the data. In view of the divergence of opinion, it was felt that a reevaluation of these modalities was required.

Methods

The evaluation of the various heat sources was made on young women in their early twenties and thirties who were undergoing treatment for sterility or for nonspecific pelvic inflammatory disease. They had no other disorders during this period of treatment. The following methods were employed to heat the tissues: the Elliott method as a source of conductive heating; a tungsten or carbon filament lamp housed in a special unit conforming to the average contour of the vaginal canal for radiant and conductive heating, and the short wave diathermy apparatus with its various modifications, pad, coil, drum and vaginal electrode, for conversive heating.

The procedure followed in these studies was similar in all cases. The patient was instructed to empty the bladder and rectum prior to treatment. She was then taken into a room with a temperature of 24 to 28 C. and free from drafts and placed on the treatment table with her hips elevated on a pillow. The temperatures of the abdominal skin, toes, finger, rectum and vagina were then taken for a period of at least one-half hour. One of the various modalities was then employed, and immediately thereafter temperatures were again measured for a succeeding period of from 30 to 120 minutes.

Temperature determinations were made by means of copper-constantan thermocouples or by mercury glass thermometers. The emf developed by the thermocouples was measured by means of either a type K-2 Leeds and Northrup potentiometer or a Brown recording potentiometer. The infrared lamp housing was adapted to measure temperatures while it was in the vagina. Seven couples arranged spirally permitted

* From the Departments of Physical Medicine and Gynecology, Graduate School of Medicine, University of Pennsylvania.
* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 10, 1949.

readings to be made along the entire vaginal canal. A dummy unit without the lamp but with a similar arrangement of thermocouples was utilized to measure temperature before and after heating. These devices were employed only to record vaginal temperatures in approximately one-half of the Elliott and infrared treatments. In all other instances a more flexible holder of the thermocouple was used.

On 12 patients a modified lamp element was used, consisting of a 15 watt incandescent bulb and with either a carbon filament or a tungsten filament, fitted into a holder made of either nylon or plexiglass. This holder conformed to the contours of the vaginal vault. Calorimetric studies indicated that the unit could produce 12 calories an hour. The heat input was regulated by means of a rheostat in the circuit. The treatment lasted one hour, during which time the temperature of the housing was checked regularly every five minutes by means of the thermocouples fitted into the bulb at various positions on its wall. The temperature of the vagina was checked also by means of the mercury thermometer. After treatment the temperatures of the vagina and rectum were taken by means of a thermometer and/or by thermocouples as described above every five minutes until they returned to the original temperatures.

On 17 patients conductive heating was applied to the vaginal cavity and nearby organs from the Elliott temperature regulator. After the rectal and vaginal temperatures had stabilized, the slightly distensible gum rubber vaginal applicator was inserted and placed in proper position with the rigid neck within the labia and the distensible portion well in the vaginal vault. The labia were protected with moist gauze. The applicator was held in place until the water pressure distended it. The apparatus was set so that the temperature of the water in the tank was 115 to 130 F. and circulated by means of the electrically driven pump at a pressure of 2.2 lbs. per square inch. The treatments were continued from 30 minutes to one hour according to the number of treatments which the patient had received previously. Temperature studies were made only on those patients who were receiving 45 to 60 minute treatments.

For conversive heating short wave diathermy was used on 27 patients. Ten were given short wave diathermy by means of the application of condenser pads applied externally over the abdomen and sacrum. Seven were given diathermy heating with the external application of drum. Ten had a 9 to 10 in. loop of cable coil applied over the lower anterior abdominal wall. Seven were treated by a vaginal electrode, which conformed well to the average potential contours of the vagina. The duration of treatment was 30 minutes.

Results

The mean maximum increase in vaginal temperature following the application of the various modalities is summarized in tables 1 and 2. The

TABLE 1. — *Temperature Changes in the Vagina Following Vaginal Heating by Elliott Method or by an Intravaginal Infrared Applicator.*

No. of Observations	Treatment	Increases in Vaginal Temperature, C							
		Maximum		5 Min. Post R		15 Min. Post R		30 Min. Post R	
		Mean	S.E.*	Mean	S.E.	Mean	S.E.	Mean	S.E.
12	Infrared lamp	0.4	0.01	0.3	0.01	0.3	0.01	—	—
17	Elliott method	1.3	0.07	1.1	0.07	0.9	0.06	0.9	0.09

* Standard error of the mean.

most marked changes were observed following the Elliott procedure. Although not shown in table 1, the alterations in rectal temperatures were of similar magnitude to those seen in the vagina. The elevated temperature was well maintained, there being a 31 per cent drop during the first 30 minutes following cessation of treatment. Cooling curves obtained after the Elliott treatments are shown in chart 1. These curves were obtained during the fourth and the eleventh treatment of the same patient. The more typical curve is seen in the left hand portion of chart 1. The curve shown on the right hand of the figure is patiently spurious. The high values were reflections of a slight leak in the rubber bag and the trapping by the recording

element of the warm water in the vaginal vault. Naturally the changes in rectal temperature were not in agreement with the vaginal values.

The infrared applicator was not as effective in raising vaginal temperatures as the Elliott procedure (table 1). The mean increase was 0.4 degree C. Again there was excellent agreement between vaginal and rectal tem-

TABLE 2. — *Maximum Temperature Changes in the Vagina, Rectum and Abdominal Skin Surface Following the Application of Short Wave Diathermy.*

No. of Observations	Mode of Therapy	Maximum Increases in Temperature, C.						Reflex Dilatation (Toes),
		Vagina		Rectum		Abdominal Surface		
		Mean	S.E.*	Mean	S.E.	Mean	S.E.	No. Observed
10	Cond. Pad.	0.2	0.11	0.2	0.09	1.8	0.41	4
7	Drum	0.2	0.11	0.3	0.09	2.1	0.46	4
8	Vaginal	0.4	0.11	0.6	0.16	0.6	0.36	5
10	Coil 9 to 10 in.	0.5	0.07	0.4	0.07	2.0	0.19	5

* Standard error of the mean.

peratures. However, this unit was as effective in elevating vaginal temperature as any of the various units employing short wave diathermy (table 2). The coil and vaginal electrode were equally effective, there being no significant difference between the two methods. This is illustrated in chart 2. They were both significantly more effective than the drum or condenser pad

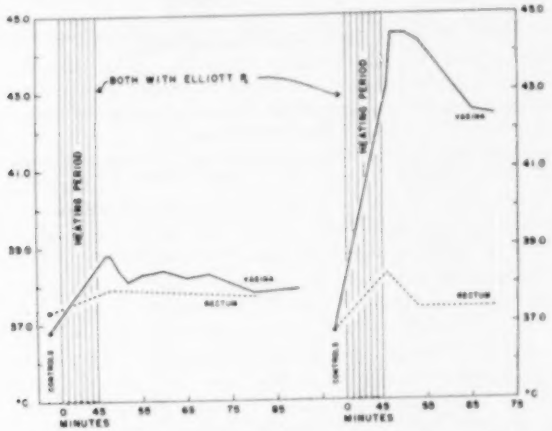


Chart 1. — Vaginal and rectal temperatures in a single subject. The left hand figure presents data obtained on the eleventh treatment given this patient and was typical both for her and other patients. The right hand figure indicates a spurious result that was observed as a consequence of a small leak in the rubber bag.

procedures. Abdominal skin surface temperatures were elevated to the same extent, approximately 2.0 degrees C., in all but the vaginal method. As anticipated, the skin temperature rise with this procedure was not marked.

One patient was treated by each of the procedures employing short wave diathermy (table 3). The results were in general agreement with the mean values presented in table 2. Another patient was studied for times during a series of 10 treatments with the coil method. The reproducibility of the

maximum elevation in vaginal, rectal and skin temperature are presented in table 3.

The clinical evaluation of the relative effectiveness of these procedures will be presented in a future communication.

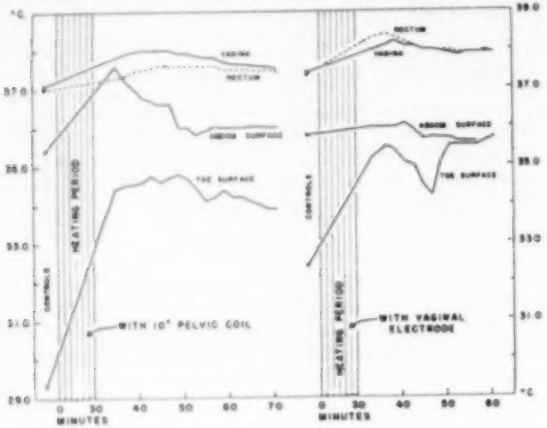


Chart 3. — Comparison of the response of one patient to two different modes of short wave diathermy therapy.

TABLE 3. — *Alterations in Temperature of Tissues Following the Application of Short Wave Diathermy*

Patient	Treatment	Increase in Temperature, C.			Reflex Vasodilatation
		Vagina	Rectum	Abdominal Surface	
D	Conduction Pad	0.0	0.1	0.8	No
D	Drum	0.5	0.4	1.7	Yes
D	Vaginal Electrode	0.8	1.0	0.3	Yes
D	Coil 10 in.	0.6	0.4	1.6	Yes
D	Coil 10 in.	0.9	0.5	2.2	Yes
R	Coil 10 in.	0.6	0.9	2.2	Yes
R	Coil 9 in.	0.4	0.4	1.3	No
R	Coil 10 in.	0.4	0.5	2.3	Yes
R	Coil 10 in.	0.6	0.4	2.4	Yes

Comment

There is no method of determining the degree of tissue heating by any modality except by direct measurement. In certain instances, estimates can be made based on pure physical calculations, but even these do not hold rigidly because tissue contact, stability of heat input and, most importantly, the rapidity or extent of blood flow in the adjacent areas are unknown elements. The situation is even more complex when short wave diathermy is used, for here there is no point of reference except the relatively unpredictable patient tolerance.

The highest mean maximum elevation of vaginal temperature was obtained by use of the Elliott procedure. With all other procedures the elevations were much lower; in only two instances was the rise as high as 1 degree C. Comparison of these results with those of other investigators[1] show agreement with at least one of them on each of the procedures employed. It appears that the differences observed may be due to the fact that most of these investigators measured their temperature while the heating devices were still operating and they assumed that these temperatures were really effective temperatures. Bengston,[2] who employed an infrared device similar to the one described here, apparently used as his criteria the surface temperature of his applicator as an indication of vaginal temperature. The present unit also could attain similarly high temperatures, but it is to be noted that immediately after removal of the unit the vaginal temperature failed to register the same high value. The temperature finally obtained and the duration of the elevation are more significant as reflections of increased temperature of the vaginal tissues.

Rectal and vaginal temperatures of the subjects employed during these tests were essentially the same (t was 1.1) prior to treatment, and this correlation was maintained following all types of treatment. However, when short wave diathermy (vaginal electrode) was employed, the rectal temperature was in several instances somewhat higher than the vaginal.

This correlation in temperature elevation of the rectum and vagina combined with the small absolute change in temperature can be explained only as due to the rapid dissipation of the heat produced through the medium of the extensive pelvic blood supply. According to table 2, reflex vasodilation of the lower extremities followed treatment only in about 50 per cent of the cases shown in this table. It seems doubtful that one could blame all the lack of temperature elevation on rapid distribution of heat from the pelvis if some reflex vasodilatation did not occur in the lower extremities. However, in table 3 only two of nine treatments failed to show the presence of vasodilatation. This seems to show also that vasodilatation does occur if the temperature elevation of the vagina and rectum is sufficient, for the two cases in which vasodilatation did not occur show the smallest elevation in temperature. In one case no elevation in vaginal temperature occurred. In the other instance vaginal and rectal elevations were each 0.4 degree C.

Examination of the results of the various modes of short wave diathermy shows that higher surface temperatures than vaginal and rectal temperatures were obtained with condenser pads, drum and cable coil. This may be indicative of the inability of methods which are applied to the body surface to induce sufficient deep heat penetration. With the vaginal electrode the rectal temperature is higher than the vaginal temperature. This may possibly be explained by the rapid radiation of heat from the vagina and the fact that the indifferent electrode was under the sacrum.

These results again raise the question as to whether high temperatures are necessary for best clinical results. The procedures used in this study certainly do not induce marked elevation of temperatures. If large temperature changes are desired, then it would appear that conventional (long wave) diathermy is the procedure of choice. Many investigators[3] have reported

1. Claussager-Madsen, L.: Nord. Med. 9:1392, 1943. Coulter, J. S., and Osborne, S. L.: Arch. Phys. Therapy 17:135, 1936. Cumberbatch, E. P.: Proc. Roy. Soc. Med. 30:211, 1937. Holden, F. C., and Gurnee, W. C.: Am. J. Obst. & Gynec. 22:87, 1931. Horowitz, E. A.; Derow, D., and Bierman, W.: Am. J. Sc. 189:565, 1935. Upton, J. R., and Benson, G.: J. A. M. A. 121:36, 1943.

2. Bengtson, B. N.: Arch. of Physical Medicine, 14:26, 1943.

3. Horowitz, E. A.; Gottesman, S.; Derow, D., and Schwarzschild, M.: Arch. Phys. Therapy 17: 122, 1936. VanPutte, P. J.: Am. J. Phys. Therapy 8:164, 1931.

temperature elevations in the vagina to levels of 110 to 113 F. A report on the clinical effectiveness of the procedures employed in this study will be reported at a later date.

Conclusions

1. The Elliott procedure was the most effective of the procedures being evaluated in this study.
2. The elevations in temperature induced were of a moderate order of magnitude. The explanation for this small change is probably complex, but a major factor is undoubtedly the profuse blood supply of the pelvic organs, which rapidly dissipates the calories being introduced.

We wish to express our appreciation to Mrs. Mary Arthur, R. N., for her assistance in the management of the patients.

The discussion of this paper will appear in a later issue of the ARCHIVES.

MEDICAL NEWS

New York Society of Physical Medicine

The November meeting of the Society will be held Nov. 1, in the New York Academy of Medicine Building. Speakers on the program will be:

Harvey E. Billig, Jr., M.D. (by invitation), "The Concept of Mobilization and Its Relation to Poliomyelitis." Sound Film. The discussion will be opened by Robert Lee Patterson, M.D. (by invitation), and Marvin A. Stevens, M.D. (by invitation).

A. W. Schenker, M.D., "Poliomyelitis. A Method of Rapid Restoration of Muscle Function." The discussion will be opened by Edgar M. Bick, M.D. (by invitation), John C. McCauley, Jr., M.D. (by invitation), and Morton Hoberman, M.D.

At the regular October meeting the program presented was as follows:

Demonstration of Ultrasonic Machine. Technical Forum. Ultrasound therapy by G. Doehner, M.D., Munich, Germany (by invitation). Discussion opened by Ernest H. Bettmann, M.D., and Maurycy Grynbaum, M.D. (by invitation). Peripheral nerve injuries during the Palestine war, by Emil Adler, M.D., and A. Beller, M.D., Jerusalem, Israel (by invitation). Discussion opened by Joseph E. J. King, M.D., and Joseph Moblaver, M.D. (by invitation).

Pennsylvania Academy of Physical Medicine

The regular November meeting will be held Nov. 16 in the surgical amphitheatre of the Philadelphia General Hospital. The program will consist of a panel discussion on poliomyelitis, Albert A. Martucci, M.D., moderator. Speakers will be:

A. C. La Rocetta, M.D., "Management of Acute Cases of Poliomyelitis."

Alex Silverstein, M.D., "Neurological Aspects of Poliomyelitis."

Burton Chance, Jr., M.D., "Bracing and Muscle Testing in Poliomyelitis."

Harold Lefkoe, M.D., "Indications for Operative Procedures in Poliomyelitis."

J. M. Johnson, M.D., "Rehabilitation in Poliomyelitis."

A sound film entitled "New Horizons" will be shown following the panel discussion.

The September meeting of the Pennsylvania Academy of Physical Medicine was held at the State Hospital for Crippled Children, Elizabethtown, Pa. Members from the Staff of the State Hospital presented the program.

Michael P. Mandarino, M.D., Elizabethtown, Treatment of Tuberculosis of the Hip by Nail Arthrodesis and Osteotomy.

Alphons Glauhitz, Elizabethtown, The Essentials of Cerebral Palsy Brace Construction.

Tom Outland, M.D., Elizabethtown, Early Roentgenographic Diagnosis of Coxa Plana.

Richard L. Shorkey, M.D., Early Diagnosis of Congenital Dislocation of the Hip.

Ian D. Murphy, M.D., Spastic Flat Foot.

Members of the Academy were invited to attend a meeting held Oct. 13 sponsored by the Philadelphia Orthopedic Club, to hear a presentation by R. Plato Schwartz, M.D., A New Approach to Cerebral Palsy. Those discussing the paper were Arthur Steindler, M.D., Bruce Gill, M.D., and Albert A. Martucci, M. D.

The following members of the Pennsylvania Academy of Physical Medicine lectured and gave demonstrations at the Scientific Exhibit of the Commission on Physical Medicine and Rehabilitation of the Pennsylvania State Medical Society, at the October meeting of the Pennsylvania State

(*Continued on page 729*)

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIALS .·.

ULTRASONICS

Our present knowledge of ultrasonics has been developed largely during the past thirty years. The medical application of ultrasonic energy is a product of the past decade; mostly since World War II. A considerable literature has appeared in this field both in Europe and America. The Germans have been especially active in the investigation of this new modality. Only a few of the numerous recent articles can be mentioned here.

In the January, 1950 issue of the ARCHIVES, Nelson, Herrick and Krusen[1] presented a comprehensive review of the literature on ultrasonics in its relation to medicine. The authors sketched the history, discussed ultrasonic apparatus, presented some basic physics, described the effects and discussed the present trends in the therapeutic application.

According to these authors, ultrasonic waves produce a rise in temperature in any medium exposed to them. The amount of this increase is dependent upon the amount of energy absorbed, and such other factors as reflection by particles in suspension, the frequency of the ultrasonic vibrations, and the occurence of the formation and collapse of cavities in the medium.

Some of the chemical effects of ultrasonic energy are acceleration of oxidative reactions, luminescence of certain liquids and depolymerization of such long chain polymers as starches and gums.

Experimental studies have demonstrated the lethal effects of ultrasonic waves on viruses, bacteria, cells, tissues, insects, and small laboratory animals. These are produced by a combination of thermal and mechanical effects. A recent study by Asche[2] of the effects of ultrasonic waves on frog embryos indicated that with light dosage growth was stimulated. Heavier dosage, however, produced death of many embryos, especially those in the younger stages, and those which did survive developed numerous deformities during continued growth. Peters[3] recently demonstrated severe injury to the spinal cord in white rats treated with ultrasonic waves resulting in paralysis below the level of the injury. Overlying muscle tissue was also severely damaged. In an interesting recent experimental study on normal and leukemic blood cells by Morrow, Bierman and Jenkins,[4] it was discovered that the white blood cells of both lymphatic and myelogenous leukemia patients were much more resistant to damage by ultrasonic energy than those of normal blood.

Veltmann and Woeber[5] demonstrated that the bacillus of tuberculosis was destroyed by ultrasonic waves. However, the energy cannot be applied in destructive strength to these organisms in living tissue. The authors

1. Nelson, P. A.; Herrick, J. F., and Krusen, F. H.: Ultrasonics in Medicine, Arch. Phys. Med. 31:8 (Jan.) 1950.
2. Asche, G.: Experimentelle Untersuchungen über den Einfluss der Ultraschalls auf die Frühentwicklung befruchteter Amphibieneier, Strahlentherapie 80:591, 1949.
3. Peters, G.: Die Wirkung der Ultraschallwellen auf das Zentralnervensystem, Strahlentherapie 79:653, 1949.
4. Morrow, P. L.; Bierman, H. R., and Jenkins, R.: Effect of Ultrasonic Vibration on the Formed Elements of Blood from Normal and Leukemic Subjects, J. National Cancer Inst. 10:1043 (Feb.) 1950.
5. Veltmann, G., and Woeber, K. H.: Der Ultraschall in der Medizin, S. Herzel Verlag, Zurich, 1949.

believed that the bacillus of tuberculosis can be sufficiently attenuated that the patient's own antibodies may complete the destruction. They have been successful in the treatment of tuberculous adenitis and lupus vulgarus with ultrasonic waves.

In this issue of the ARCHIVES appears an interesting study by Nelson, Herrick and Krusen[6] on the heating of bone marrow, bone and adjacent tissues by ultrasonic waves. It is shown that the temperature of bone and bone marrow is raised rapidly to relatively high levels; much higher than with any other type of energy so far reported. This is a selective effect which will have to be reckoned with when ultrasonic waves are applied therapeutically.

As indicated by Nelson, et al.,[1] there has been practically no effort made to the present time to conduct controlled clinical studies in the field of ultrasonic therapy although a considerable amount of clinical work has been done in Europe. The diseases reported from abroad as being successfully treated are sciatica, brachial neuralgia, arthritis, periarthritis, rheumatoid spondylitis, Dupuytren's contracture, endarteritis obliterans, abscess, tuberculous lymphadenitis, cutaneous ulcers, scleroderma, warts, eczema, asthma, chronic emphysema, adnexitis, prostatitis, otosclerosis and several others.

In this country Rosenthal[7] recently reported the clinical use of ultrasonics in 143 cases including osteoarthritis, sciatica and neuritis, fibrositis and myalgias, bursitis, lumbar strain, thrombosed hemorrhoids, asthma and emphysema, kidney stones and acute cervical lymphadenitis. He summarized his article by saying, "We have been able to demonstrate to our satisfaction the therapeutic effectiveness of this new modality in clinical medicine, in posttraumatic conditions, in painful afflictions of the muscles, nerves and joints, and in the amelioration of localized congestive disturbances."

There have been several reports of the use of ultrasonic waves in the treatment of malignant tumors. There have also been warnings against this practice. The Ultrasonics Congress at Erlangen in May, 1949 refused to endorse the treatment of carcinoma with ultrasonics. However, it appears that further research in this direction is indicated.

Contraindications to ultrasonic therapy have not been fully determined. Buchtala[8] believed that ultrasonic energy should not be applied to (1) growing bone, since there is some evidence that early ossification may result; (2) the gravid uterus; (3) the reproductive glands; (4) the region of the cervical ganglia in patients with cardiac disease and (5) the extremities in peripheral vascular disease.

Let us adopt a sound scientific attitude toward ultrasonics. An adequate physiological background should be developed by such fundamental investigations as the one appearing in this issue of the ARCHIVES. In the clinical application of this new agent accurately controlled studies are in order to determine its place in the armamentarium of physical medicine.

6. Nelson, P. A.; Herrick, J. F., and Krusen, F. H.: Temperatures Produced in Bone Marrow, Bone and Adjacent Tissues by Ultrasonic Diathermy, Arch. Phys. Med. 31:687 (Nov.) 1950.
7. Rosenthal, H.: Ultrasonics in Clinical Medicine, J. Aviat. Med. 21:265 (June) 1950.
8. Buchtala, V.: Die Ultraschallwirkung auf den wachsenden Knochen: Ergebnisse tierexperimenteller Untersuchungen an jungen Hunden, Strahlentherapie 78:127, 1948.

Medical News
(Continued from page 726)

Medical Society in Philadelphia, October 16-17-18, 1950.

Temple Fay, M.D., "Physical medicine and rehabilitation in cerebral palsy."

Burton Chance, M. D., "Physical medicine and rehabilitation in poliomyelitis."

Francis Sweeney, M.D., "Crutch walking demonstration."

Harold Lefkoe, M.D., "The proper fitting of a prosthesis following amputations."

Mr. R. Cavaliere, "The functions and accomplishments of the Pennsylvania bureau of rehabilitation."

J. Hollander, M.D., "The role of physical medicine in chronic arthritis."

I. Kornblueh, M. D., "Demonstration of bed exercises."

Jessie Wright, M.D., "Body mechanics."

Nicholas Mauricllo, M.D., "Physical medicine in the management of the neuropsychiatric patient."

Herman Rudolph, M.D., "The home management of the hemiplegic patient."

Herman J. Beatty, M.D., "A clinical demonstration of the DeLorme heavy resistive, repetitive exercises."

Albert Martucci, M.D., Chairman of Commission.

Chicago Society of Physical Medicine and Rehabilitation

The regular monthly meeting of the Chicago Society of Physical Medicine and Rehabilitation will be held at 8 P.M., Nov. 22, 1950 at the Sarah Morris Amphitheatre, Michael Reese Hospital, 29th St. and South Ellis Ave., Chicago. Dinner at 6:30 P.M. will precede the scientific program at the Coffee Shop of Michael Reese Hospital.

The topic of the program in charge of Dr C. O. Molander, M.D., will be "Use of Cortisone and ACTH in the Treatment of Arthritis; Its Relationship to Physical Medicine," presented by Edward F. Rosenberg, M.D., Chief of Arthritis Clinics, Michael Reese and Mount Sinai Hospitals, and Assistant Professor of Medicine, Chicago Medical College. A short business meeting will follow the dinner. The medical profession is cordially invited.

The program for the succeeding meetings is as follows:

Jan. 24, 1951, West Side Medical Center. Exact place to be announced. Guest speaker: Arthur H. Steinhaus, Professor of Physiology, George Williams College.

Feb. 28, 1951, Cook County Hospital, 1835 West Harrison Street. To be presented by Disraeli Kobak, M.D.

Mar. 28, 1951, West Side Medical Center. Exact place to be announced. Guest Speaker: Harold Sofield, M.D., Associate Professor, Bone and Joint Surgery, Northwestern University Medical School.

Apr. 25, 1951, Hines Veterans Administration Hospital. To be presented by Louis B. Newman, M.D.

May 23, 1951, West Side Medical Center. Exact place to be announced. Guest speaker: Frank H. Krusen, M.D., Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

"Electromyography in Physical Medicine and Rehabilitation," was the topic presented at the meeting held Oct. 25, by H. Worley Kendell, M.D., and staff, from the department of physical medicine and rehabilitation of the University of Illinois College of Medicine.

Louis B. Newman, M.D.
President.
Arthur A. Rodriquez, M.D.,
Secretary-Treasurer.

Personals

Dr. Howard F. Polley of Rochester, Minnesota, recently spoke on "The Collagen Diseases" at the annual meeting of the American Academy of Ophthalmology and Otolaryngology held at the Palmer House, Chicago, October 8-13.

Dr. Jessie Wright, medical director, D. T. Watson School of Physiatrics, has been appointed a member of the National Medical Civilian Consultants to the United States Air Force Medical Service (USAF).

Dr. Bruce B. Grynbaum has recently been appointed Director of Physical Medicine and Rehabilitation at the Department of Hospitals, New York City. Dr. Grynbaum is also instructor at New York University — Bellevue Medical Center.

Dr. Howard A. Rusk has been named chairman of the health resources advisory committee of the National Security Resources Board. The appointment was made by W. Stuart Symington, chairman of the NSRB. The National Security Resources Board, as a whole, will make recommendations to determine civilian and industrial mobilization and to designate the allocation of power in the event of war.

As a part of the Graduate Fortnight of the New York Academy of Medicine, Howard A. Rusk, M.D., E. W. Bergman, M.D., and Hans Kraus, M.D., appeared on a panel discussion on "Rehabilitation in Musculoskeletal Disorders." Other participants were Alfred R. Shands, Jr., M.D., and Robert C. Darling, M.D.

Miss Signe Brunnstrom, Director of Professional Education at the Kessler Institute for Rehabilitation, Pleasant Valley Way, West Orange, New Jersey, has gone to Athens, Greece, where for nine months she will conduct a school for physical therapists at the University of Athens. Miss Brunnstrom is being sent to Greece as a Visiting Lecturer by the State Department and

the Near East Foundation, under the 1950 Fulbright program. When Miss Brunnstrom returns from Greece, she will resume her duties at the Kessler Institute for Rehabilitation.

Workshop on Rehabilitation

The Office of Vocational Rehabilitation, Federal Security Agency, will be one of the sponsors of a workshop conference on rehabilitation of the severely disabled starting September 25 in New York City.

Joint sponsor of the four-weeks course is the Institute of Physical Medicine and Rehabilitation. The course will be under the auspices of the New York University School of Medicine and graduate academic credit will be offered by the university's School of Education for successful completion of the course.

New School for Social Research

A new course covering problems of both psychological and physical rehabilitation of the aged, the handicapped, and the chronically ill is being conducted in the New School for Social Research (New York) this fall by Michael M. Dacso, M.D., chief of the department of physical medicine and rehabilitation of Goldwater Memorial Hospital. Joining Dr. Dacso as instructors in various phases of the course will be Dr. Morris Grayson, director of psychiatric research in rehabilitation of the Institute of Physical Medicine and Rehabilitation of New York University-Bellevue Medical Center; Joseph Levi, research clinical psychologist of the New York University-Bellevue Center; James F. Garrett, chief of the special rehabilitation procedures division of the Veterans Administration; Eugene J. Taylor, member of the editorial staff of the New York Times and field representative of the National Society for Crippled Children and Adults; Henry Viscardi, Jr., chairman of the permanent committee for employment of the physically handicapped of the National Office Management Association, and Martha L. Turnblom, speech therapist, Goldwater Memorial Hospital.

Third Latin-American Congress of Physical Medicine

The Latin-American Congress of Physical Medicine has received an official diplomatic communication from the President of the Republic of Santo Domingo that they are desirous of holding the third Latin-American Congress of Physical Medicine and Rehabilitation in the National University School of Medicine in the capital city of Trujillo sometime in 1951.

It is estimated that the cost of the trip will be in the neighborhood of $350.00, transportation to be arranged by special place from New York. Residence will be arranged at the new Hotel Jaragua. Further information may be obtained from Madge C. L. McGuinness, M.D., Secretary, or Cassius Lopez de Victoria, M.D., Executive Director, Latin-American Congress of Physical Medicine.

"Self-Help Devices for Rehabilitation"

"Self-Help Devices for Rehabilitation" is the title of a pamphlet issued by the Institute of Physical Medicine and Rehabilitation. In this manual, some of the devices and gadgets already discovered, and tested by patients at the Institute or elsewhere, are pictured and described. The intention is to make available knowledge of all existing inventions and discoveries in the field, in the hope that everyone may find something from which he can derive greater independence, efficiency, or comfort. This study has been made possible under a grant from the National Foundation for Infantile Paralysis. This is the second in the series of reports being issued in connection with this project.

American Association for the Advancement of Science

The 117th Meeting of the AAAS will be held in Cleveland, Ohio, Dec. 26 to 30, 1950, with programs in every principal field of science from astronomy and botany to, and including, zoology. All 17 of the Association's sections and subsections, and more than 40 participating societies and organizations, are completing plans for an aggregate of more than 200 sessions. The American Museum of Atomic Energy, which is operated for the United States Atomic Energy Commission by the Oak Ridge Institute of Nuclear Studies, has completed arrangements for an extensive exhibit, part of which will be a model of an Atomic Pile. On December 29 and 30 there will be a four-session symposium on "Biological Effects of Radiation."

Noted Educator Named to Red Cross Blood Post

Dr. Russell Haden, medical educator and recently head of the Department of Medicine at the Cleveland, O., Clinic, has been appointed medical director of the Red Cross National Blood Program.

Dr. Haden will direct the medical aspects of the blood program as it is expanded to provide blood, plasma and other derivatives for the nation's hospitals and for military and civil defense needs. He will work with Dr. Ross T. McIntire, chairman of the blood program's committee on medical policies and procedures. This committee of leading surgeons and hematologists is supervising the planning and development of Red Cross blood collection centers and the coordination of the country's private and institutional blood banks in carrying out the responsibilities assigned to Red Cross by the military and defense authorities.

World Congress for Cripples to Be Held in Stockholm in September, 1951

The Fifth World Congress of the International Society for the Welfare of Cripples will be held in Stockholm, Sweden, September 9 through 14, 1951. The Congress, at which representatives of the twenty-five national organizations which are members of the International Society are expected, will consider programs for the prevention of crippling and various aspects of the rehabilitation of physically disabled persons. It is also expected that representatives of the United Nations, World Health Organization and other governmental organizations will be present. The meetings of the Congress will be of interest to doctors and other medical personnel, occupational and physical therapists, social workers and those interested in the education, training and employment of the disabled.

An accredited organization to the United Nations, The International Society for the Welfare of Cripples, formerly the International Society for Crippled Children, has been engaged in work for the physically disabled for almost thirty years. The International Society also sponsored the First Inter-American Conference on Rehabilitation of the Crippled and Disabled held in Mexico City in 1948 and this year co-sponsored the First Institute on Rehabilitation held in Puerto Rico and an International Conference on the Education of Handicapped Children in Geneva.

A federation of national societies of the various countries of the world interested in programs for the physically disabled, the International Society for the Welfare of Cripples serves as an international clearing house for technical and social developments in rehabilitation and services to the handicapped. The affiliated member in the United States is The National Society for Crippled Children and Adults, which has its headquarters in Chicago. The offices of the International Society are located in New York.

College Extension Program (Hospital and Home Study) for the High School Graduate of College Calibre Who Is Physically Handicapped

Currently, Boston University General College is conducting an experiment in higher education for hospitalized veterans — and for discharge patients on limited work tolerance.

Two years ago there was inaugurated a study program in General Education for hospitalized veterans at the Rutland Heights Veterans Administration Hospital, at Rutland Heights, Massachusetts, under Government sponsorship. It began with a group of ten T. B. patients, all with a very limited work tolerance, who were provided with recordings of the lectures as they were given at the General College to the Freshman Class. When lantern slides were shown to those in attendance at the college to illustrate lecture material, photographs of the slides were made and sent with the recording. When practicable a member of the Faculty visited the group at the hospital for conference and discussion work.

When the students were discharged from the hospital, still with work tolerance so limited that they could not attend the regular classes at the college, they were provided with Gray Audograph machines for home use, mimeographed materials, books, and photographs of slides. When it was possible the student came to the college for conferences with members of the four departments (English, Science, Human Relations, and Guidance). Three of the original group of ten students completed the work of the Freshman year and were full-fledged sophomores in regular attendance by September, 1949, with their health and morale so improved that in competition with more than 500 other students all three maintained grades sufficiently high to earn places on the Dean's List in each of the three terms this year.

Sclerosis Society Donates $100,000 for NYU Research

To investigate and study multiple sclerosis and related disorders, the National Multiple Sclerosis Society has made a grant of more than $100,000 to the New York University Postgraduate Medical School. The new research clinic will be located at the New York University-Bellevue Medical Center and will be staffed by members of the school's faculty.

One of the unique features of the clinic will be the establishment of a multiple sclerosis study panel. The panel will consist of representatives of leading medical centers in the New York area where similar research is underway.

Newly Registered Therapists

September 12, 1950

Burrill, Cornelia A., Comstock Hall, U. of Minnesota, Minneapolis, Minn.

Garlough, Mrs. Faye P., Route 1, New Brighton, Minn.

Ghent, Geraldine H., 185 Maria Ave., St. Paul, Minn.

Haak, Mr. Howard A., 220 N. 10th Ave. E., Duluth 5, Minn.

Lee, Barbara J., Dawson, Minn.

Mitchell, Dorothy E., 3616 45th Ave. S., Minneapolis 6, Minn.

Peterson, Jacquelyn A., 107 S. Main, New Richmond, Wisc.

Pierce, Eugenia M., 412 8th St. S., Virginia, Minn.

Pitzel, Mrs. Barbara A., 2404 4th Ave. E., Hibbing, Minn.

Stone, Loraine M., 3800 S. Thomas Ave., Minneapolis, Minn.

BOOK REVIEWS

S. WIER MITCHELL, NOVELIST AND PHYSICIAN. By *Ernest Earnest*. Pp 279, with 3 illustrations. Price, $3.50. University of Pennsylvania Press, Philadelphia, 1950.

The name of Weir Mitchell, to most persons interested in Physical Medicine, is only associated with his work on injuries to nerves and their treatment. His accomplishments in other medical fields such as psychiatry and research, his literary ability which included numerous novels, beautiful poetry and translations, his civic and social activities will surprise these readers. The biographer has stressed his human qualities rather than his professional achievements. His boyhood in Philadelphia before the Civil War, his work in the army hospital, his association with his many illustrious contemporaries and above all, his relationship with his family is extremely pleasant reading. Weir Mitchell was an unusual man whose versatility has not been sufficiently appreciated.

The author of this book has a very pleasing and lively style of writing. He has caught the character of Mitchell and has presented it most capably.

APPLICATION OF MEASUREMENT TO HEALTH AND PHYSICAL EDUCATION. By *H. Harrison Clarke*, Ed.D., Director of Graduate Studies, Springfield College, Springfield, Mass. Second Edition. Cloth. Price, $6.00. Pp. 493 with 37 illustrations. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y., 1950.

This volume, designed as a text and limited reference book for physical educators, describes and discusses many tests and evaluation procedures used in the United States by physical educators in schools and colleges. The material is somewhat expanded over the first edition, but unchanged in plan and orientation. Although it lays no claim to complete description of available tests, those taken up are described in sufficient detail to make the book useful as a manual for administering the tests. The author groups the measurements under physical fitness, social efficiency and skills and appreciations. The distinction between tests under the first two categories is often rather arbitrary.

The book should be of special value as a reference to a limited group of medical readers concerned with health evaluation of normal young people. Of general interest is the clear, brief description of the aims and theories of physical education. The physiologic rationale for tests is only briefly and often inadequately presented; on the other hand the criteria of valid accurate measurement are superbly emphasized.

AN ATLAS OF HUMAN ANATOMY. By *Barry J. Anson*, Ph.D., Professor of Anatomy, Northwestern University Medical School. Cloth. Price, $11.50. Pp. 518 with 1301 illustrations, some in color. W. B. Saunders Company, 218 West Washington Square, Philadelphia 5, Pa., 1950.

This is an unusually splendid atlas of human anatomy. The author, Dr. Barry J. Anson, is not only an outstanding anatomist but a teacher of no mean caliber. Both these distinctive qualifications permeate the entire work which is the fulfillment of a carefully thought out project covering many years.

The pictorial contents of 1300 plates are based upon all new dissections, serially prepared, and upon variable morphological features stastically presented. Anomalies, as such, have been minimized; instead, they find their place as predictable elements in a natural succession of variations. The author has limited the contents of this volume to those features of human structure which are demonstrable in regular study of the cadaver. Mindful of the needs of graduate and postgraduate students the material has been prepared in such a way as to be continuously useful to the reader whether a student or a practitioner of medicine.

This atlas of gross human anatomy is not only essential for the medical student but also for the busy physician and surgeon who is continually in need of a good reliable reference work. This volume should prove invaluable to the physiatrist and physical therapist because anatomy is such an integral and vital part of physical medicine. This atlas is most highly recommended. The publisher is to be congratulated for producing such a work of art.

BRUCELLOSIS (UNDULANT FEVER) CLINICAL AND SUBCLINICAL. By *Harold J. Harris*, M.D., F.A.C.P. with the assistance of *Blanche L. Stevenson*, R.N. Foreword by *Walter M. Simpson*, M.S., M.D., F.A.C.P. Second edition, revised and enlarged. Cloth. Price, $10.00. Pp. 617, with 111 illustrations, 12 in full color. Paul B. Hoeber, Inc. (Medical Book Department of Harper & Brothers), 49 E. 33d St., New York 16, 1950.

This second edition brings up to date the knowledge of this prevalent disease. The author is responsible in a large measure in urging the recognition by the profession of this clinical entity. His experience is secured from the study of more than 700 patients. The new edition includes the information gained from 450 patients diagnosed and treated since 1941. Dr. Harris is an outstanding authority on brucellosis.

The need for a revision was necessary. The

diagnostic measures have been more thoroughly tested and can now be better evaluated and the methods of treatment have changed considerably in the past decade. The results secured with the newer antibiotics are given. A new chapter has been added on the psychosomatic aspects of chronic brucellosis with the psychological studies of the effects produced by a chronic disease such as brucellosis. Other additions and revisions make this an up-to-date and authoritative book on the subject.

The work should interest not only the students and investigators of brucellosis but general practitioners and the specialists in other fields. The following quotation from the foreword aptly expresses the general tone of the book, "The first consideration in the diagnosis of brucellosis is to think of brucellosis. Doctor Harris has prepared a clear, concise, convincing and authoritative statement of present day knowledge of brucellosis. This monograph will undoubtedly achieve the purpose for which it was prepared, namely, to help the great mass of people suffering from brucellosis by making their physician brucellosis-minded."

HISTOPATHOLOGY OF THE SKIN. By *Walter F. Lever*, M.D., Instructor in Dermatology, Harvard Medical School; Assistant Dermatologist, Massachusetts General Hospital; Associate in Dermatology, Peter Bent Brigham Hospital; Consulting Dermatologist, Massachusetts Eye and Ear Infirmary. Cloth. Pp. 449 with 221 illustrations. Price, $10.00. J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pa., 1949.

An excellent reference text for both general pathologist and dermatologist. The essential histopathology of cutaneous diseases is well described and illustrated by photomicrographs. Clinical features are summarized and extensive bibliographic material appended.

A. M. A. INTERN'S MANUAL. Cloth. Price, $2.25. Pp. 201. W. B. Saunders Co., 218 W. Washington Square, Philadelphia 5, 1948.

This pocket manual contains a vast amount of condensed information, especially useful to interns and advanced medical students but of value to any physician who needs a brief compend of basic information at hand for rapid consultation. Only three chapters — Internships and Residencies, Lawful Scope of Intern Practice and The American Medical Association — are of value only to interns or those students who expect soon to be interning; the other chapters, dealing with Clinical and Laboratory Data, Drug Administration, Materia Medica, Acute Poisoning, Diet and Nutrition and Physical Medicine, summarize the basic principles of general practice. As suggested in the chapter on Physical Medicine, the information given "may be thought of as a check-list for making sure that a patient receives the advantage of everything that modern medical science has to offer."

The manual is attractively printed and of convenient size; it is notably well indexed.

PHYSIOLOGY AND ANATOMY. — By *Esther M. Greisheimer*, B. S., in Education, M.A., Ph.D., M.D., Professor of Physiology, Temple University School of Medicine, Philadelphia; Formerly Professor of Physiology, Woman's Medical College of Pennsylvania, Philadelphia; Formerly Associate Professor of Physiology, the University of Minnesota, Minneapolis. Sixth Edition. Cloth. Price, $4.00. Pp. 841 with 478 illustrations, including 52 in color. J. B. Lippincott Company, East Washington Square, Philadelphia, Pa., 1950.

Publication of the sixth edition of Professor Greisheimer's book is evidence that it is popular and has filled the purpose of its author. It is a text written for nurses and would be of value to the student in physical education. The present volume has been revised and brought up-to-date. There have been revisions of the chapters on the physiology of the muscular system; on the blood; as well as the chapter on internal secretions. A more adequate presentation has been made for the chapter on special senses, for instance, pain and visceral sensation have been more adequately dealt with. In the chapter on respiration a description of pulmonary function tests, bronchospirometry, anoxia and artificial respiration have been included. The vitamins have been brought up-to-date. In the chapters on the circulatory system the Blalock-Taussig operation has been included. The discussion of hemorrhage and shock has been considerably broadened. Fifteen new illustrations have been used.

The aim of the author to keep the nurse abreast of the times has been admirably fulfilled.

The book is not only well illustrated but written in clear concise English. The material is also presented in a logical manner. The anatomy of a system is presented first, and then the physiology of the same system. Practical considerations are found at the close of each chapter because of their general interest. The contents of the book are divided into the following units: one, the body as an integrated whole; two, the erect and moving body; three, integration and control of the body by the nervous system; four, maintaining the metabolism of the body; five, the reproductive system; and six, aviation. The volume closes with an excellent reference of articles and books and a glossary. The book is highly recommended as a text for schools of nursing. The physical therapist will find it an excellent reference book.

AN INTRODUCTION TO THE STUDY OF EXPERIMENTAL MEDICINE. By *Claude Bernard*. Translated by *Henry Copley Greene*, A.M., with an introduction by Lawrence J. Henderson, Professor of Biological Chemistry, Harvard University. Cloth. Pp. 226. Price, $3.00. Henry Schuman, Inc., 20 East 70th Street, New York 21, N. Y., 1949.

A true classic of medical literature, serving as an inspiration to all in the field of research. It is

written in a personal, living style which defies age. A worthy addition to anyone's medical library and a book to be read, not just collected.

HANDBOOK OF DIGESTIVE DISEASES. By *John L. Kantor*, M.D., F.A.C.P., Gastroenterologist, Montefiore Hospital, New York, and *Anthony M. Kasich*, M.D., F.A.C.P., Lecturer in Medicine, Columbia University, New York. Second edition. Cloth. Price, $11. Pp. 658, with illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., 1949.

At the time of Dr. Kantor's death, a revision of the first edition of his work was under way. Dr. Kasich, an associate of Dr. Kantor's, undertook the completion of this task and although this volume is labeled a second edition, it is really a new book.

This book covers all the various diseases and disorders of the gastrointestinal tract. Two chapters on diagnostic methods are particularly good. The orderly and sound suggestions for the history-taking and physical examination should be particularly helpful. Fifty-two pages are devoted to intestinal parasites, important as these protozoa are in producing gastrointestinal pathology and probably too frequently forgotten, the use of this much space in a handbook might be questioned. The last two chapters are contributed by collaborators, one on gastrointestinal allergy and the other on psychiatric aspects of digestive diseases. This latter chapter with its emphasis on the Freudian approach to neurosis will not meet with general acceptance.

This is a new and up-to-date book. It is concise and should be valuable for the busy practitioner.

PSYCHOLOGY. Principles and Applications. By *Marian East Madigan*, Ph.D., Specialist, Research Department, Milwaukee Vocational and Adult Schools, Visiting Professor, Summer Sessions, University of Arizona, Educational Measurement and Guidance. Cloth. Price, $4.25. Pp. 403 with 30 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., 1950.

This text book of psychology should prove to be a valuable and adequate beginner text for student nurses, physical therapists and college students.

The text centers on four units: the nature and methods of psychology, the essentials of learning, the biological and social bases for behaviour and personality and adjustment. At the beginning of each unit an outline has been given which provides the student with an overview as well as the objectives that must be achieved. Each of the seventeen chapters closes with a set of questions designed to test the student's comprehension of the material. For the purpose of the course the author has considered psychology as the scientific behaviour of the individual as a whole; that is, the study of the factors in the make-up of the individual as well as the environment in which he finds himself. Dr. Madigan has written this volume in an interesting style using clear, concise language. For schools of nursing and physical therapy this text is highly recommended.

KINESIOLOGY. By *Laurence E. Morehouse*, Ph.D., Associate Professor of Physical Education, The University of Southern California; Interim Chief, Performance Physiology Section, United States Air Force School of Aviation Medicine; and Formerly Research Fellow, Harvard Fatigue Laboratory; and *John M. Cooper*, Ed.D., Associate Professor of Physical Education, The University of Southern California; Formerly Associate Director of Physical Training, Army Air Forces Training Command; and Formerly Athletic Coach, University of Missouri. Cloth. Pp. 435, illustrated. Price, $4.50. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Missouri, 1950.

This is a study of normal man in motion, with emphasis on various athletic activities. The physical and anatomical background of bodily mechanics is included for the physical education and physical therapy student, with the essentials of neuromuscular physiology. Some excellent action photographs are utilized to advantage in explaining details of balance.

Recommended as a reference text for physical education students. For physical therapy students inclusion of some pathologic conditions would be desirable.

PREVENTIVE AND CORRECTIVE PHYSICAL EDUCATION. By *George T. Stafford*, Ed.D., Professor of Physical Education, University of Illinois. Revised Edition. Illustrated with photographs and drawings by Gene A. Logan. Cloth. Pp. 312. Price, $3.75. A. S. Barnes & Company, 101 Fifth Avenue, New York 3, N. Y., 1950.

The methods of physical education developed during World War II are embodied in this revised edition. The author points out the need for a total program of health education which begins with teaching hygienic habits to the school child so that good body mechanics may be well established in the adult. The latter feature is the theme of the book. What constitutes good body mechanics, how and from what cause poor posture results, together with a program for correction, are well described in the first six chapters. The author explains how physical education can be extended to physically handicapped individuals attending various schools. Minor defects may be corrected if the educators realize the need for assistance among the disabled and do not place all the emphasis upon the normal or athletic individual. In addition there are three chapters devoted to heart disturbances, malnutrition, poliomyelitis and cerebral palsy.

There are a number of good photographs, illustrations and charts, and each chapter has its

own adequate bibliography. The book may be recommended to students and teachers of physical education.

LYDIA PINKHAM IS HER NAME. By *Jean Burton*. Fabrikoid. Price, $2.75. Pp. 279. Farrar, Straus & Company, Inc., 53 East 34th Street, New York 16, 1949.

Lydia Estes Pinkham, who was born twenty miles from Boston, but seldom traveled that far, found it possible within a narrow orbit to pursue a life full of mental and moral stimulation, to become America's first successful business woman, to originate an entirely new form of advertising, to write the first reliable facts-of-life treatise, and to provide the public with a revolutionary concept: that one could be healthy though female. The physical properties behind these achievements were an old herb remedy and Mrs. Pinkham's motherly face. Behind the physical properties were a family of almost terrifying energy who believed in their product and were determined that the public should do likewise. What began as a pin money business after the panic of 1873 grew into the multi-million dollar Lydia E. Pinkham Medicine Company which through the years was to spend some $10,000,000 displaying the face of the lady from Lynn, Massachusetts, throughout the world.

At the hands of Jean Burton, already well known for her biographies the personality behind the face of Lydia Pinkham comes to life. It requires the skill of such a biographer not to allow the volume to end on an anticlimatic note, when it comes to the later developments in the Lydia E. Pinkham Medicine Company, the sharp legal contests between two groups of heirs, the male Pinkhams and the female Goves, and to the sensational revelations of Samuel Hopkins Adams in "The Great American Fraud" about the high alcohol content. The Food and Drug Administration enforced in 1925 a clarifying change in labeling, but after considerable negotiations allowed the advertising claim that the Compound was a uterine sedative. And so the advertising of the oldest American "nostrum" merrily continues and Lydia Pinkham lives on in folklore and ballad: "Lizzie Smith had tired feelings, Terrible pains reduced her weight, She began to take the Compound, Now she weighs three hundred and eight. Elsie W. had no children. There was nothing in her blouse. So she took some Vegetable Compound; Now they milk her with the cows." The book makes entertaining and interesting reading all the way through.

NURSING AN ART AND A SCIENCE. By *Margaret A. Tracy*, R.N., A.B., M.S., Dean, University of California School of Nursing, San Francisco and Berkeley. Third edition. Cloth. Price, $4.00. Pp. 625 with 183 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo.

This textbook represents the combined consideration of the faculty of a school of nursing in accordance with the scientific and educational concepts of the day. For instruction in nursing in relation to the various branches of medicine with their ever-expanding contents, interpretation by experts or specialists is required. In this, the author had the help of many members of the Staff of the University of California Medical School. In step with the developments in the medical and the social sciences, the text includes instruction not alone in a wide variety of established nursing procedures, but also in diagnostic procedures. Hence the three parts of the book describe: I, General principles of nursing; II, Diagnostic procedures and assistance in them, and III, Therapeutic procedures. Among the latter is included a good chapter on heat and cold as therapeutic agents. In the third edition cognizance is taken of such newer developments in medical care as the use of antibiotics and early ambulation, and 48 new pictures have been added to the excellent series of illustrations previously presented. This is indeed a splendid volume which should prove useful to nurses everywhere.

ELECTROCARDIOGRAPHY. Fundamentals and Clinical Application. By *Louis Wolff*, M.D., Visiting Physician, Consultant in Cardiology and Chief of the Electrocardiographic Laboratory, Beth Israel Hospital, Boston, Mass. Cloth. Price, $4.50. Pp. 187, with 110 illustrations. W. B. Saunders Company, 218 W. Washington Sq., Philadelphia 5; 7 Grape St., Shaftesbury Ave., London, W.C.2, 1950.

Beginning with an explanation of dipoles and membrane potentials the author proceeds to an exposition of Einthoven's equilateral triangle theory and then explains the genesis of various normal and abnormal electrocardiograms. The book does not undertake to explain the construction and operation of an electrocardiograph, and undertakes only to discuss interpretation. The skeptical student who wonders how often the electrocardiographer's fine-spun diagnoses have been verified by post mortem findings will not find this question answered, and the critical physiologist who wonders why Einthoven chose an equilateral instead of a right-angled triangle will close the book still wondering. A physician wishing to know the meaning of cabalistic symbols like aV_R and N/2 will find in the index an entry promising information about "Leads, designation of" on pp. 39, 41, 43, and 84. Unfortunately pp. 71 to 87 were missing from the copy received for review, and pp. 39, 41, and 43 do not explain the symbols used by the author on p. 159. This book can be recommended only to readers who have time and patience for abstractions, and will be of little help for quick reference.

THEORY OF HEARING. By *Ernest Glen Wever*, Professor Psychology, Princeton University. Cloth. Price, $6.00. Pp. 484 with illustrations. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16; Chapman & Hall Limited, London, 1949.

To those interested in the development of the physiology of hearing, the names of Wever and Bray are almost synonymous with the beginning of modern development of this field with their work on the electrical response of the ear. Out of this work has grown a wealth of material from such laboratories as the author's laboratory in Princeton,

the laboratories at Harvard, the University of Rochester and a number of others, which has entirely changed our insight not only in the mechanics of the ear, but also in the theories of hearing. Much of the literature in this field has been spread in psychological, physiological and medical journals. The authors have done a great service in collecting this material and making it available in book form. Together with a volume on acoustic measurement technics, published by the same publishers, we now have for the first time in the English language a good review of the field of physiological acoustics. The book goes through the different theories of hearing and the experimental evidence for and against them. The author's own theory necessarily takes a major part of the book, and as the modern development of hearing is so closely related with the discussions of this theory, this is as it should be.

This book should be in the library of every physiologist interested in physiology of hearing, and of every physiatrist or scientific worker who deals with the problems of hearing aids and the improvement of hearing. While this is not a clinical book it provides the physiological basis for the scientific approach to the problem of defective hearing. This book may well be considered a classic in its field.

TRACK AND FIELD ATHLETICS. By *George T. Bresnahan*, Assistant Professor of Physical Education, formerly Track Coach, State University of Iowa; and *W. W. Tuttle*, Ph.D., Professor of Physiology, State University of Iowa. Cloth. Third edition. Pp. 500. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Missouri, 1950.

A detailed analysis of track and field events is presented. This includes ideal form in each event, methods of training including diet and types of physical therapy applicable to normal athletes. Properly, treatment of injuries is referred to the medical profession. An excellent book for track coaches and physical education students.

MANUAL OF RHEUMATIC DISEASES. By *W. Paul Holbrook*, M.D., and *Donald F. Hill*, M.D., Tucson, Arizona. Cloth. Price, $4.25. Pp. 190 with 118 illustrations. Year Book Publishers, Inc., 200 East Illinois Street, Chicago, 11, Ill., 1950.

This is an excellent book covering the most common rheumatic diseases. It considers the diagnosis by the usual clinical signs, the simple laboratory measures and the X-Ray findings, the differential diagnosis and treatment. All controversial issues are omitted. Only the accepted forms of therapy are given. The last chapter entitled "Prevention and correction of deformities" is alone worthy of possession of the book. The two authors have carried an enviable record in their consideration of the deformities. Their results have been remarkable.

If every physician were to read this book he would know practically all he should know to diagnose a rheumatic condition and how properly to care for it. This book should appeal particularly to the family physician who sees most of these patients first and thus could do much to prevent the deformities.

PHYSICIAN'S HANDBOOK. By *Marcus A. Krupp*, M.D., Assistant Clinical Professor of Medicine, Stanford University School of Medicine; Director, Clinical Pathology, Veterans Administration Hospital, San Francisco; *Norman J. Swet*, M.D., Assistant Professor of Medicine, University of California School of Medicine, San Francisco; *Ernest Jawetz*, Ph.D., M.D., Associate Professor of Bacteriology and Lecturer in Medicine and Pediatrics, University of California School of Medicine, San Francisco; *Charles D. Armstrong*, M.D., Clinical Instructor in Medicine, Stanford University School of Medicine. Paper. Sixth Edition. Pp. 380. Price, $2.50. University Medical Publishers, Postoffice Box 761, Palo Alto, California, 1950.

A mine of information emphasizing laboratory findings and technics. Drugs, hormones, vitamins and diets are also included and brought up to date in this new edition. Some fundamental information on Physical Medicine might well be included.

PRIMER OF ALLERGY. A Guide Book for Those Who Must Find Their Way Through the Mazes of This Strange and Tantalizing State. By *Warren T. Vaughan*, M.S., M.D. Third Edition, Revised by *J. Harvey Black*, M.D. Cloth. $3.50. Pp. 175, with illustrations by *John H. Tillery*. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1950.

This is the third edition of the very popular book of Dr. Vaughan. The work was written originally by Dr. Vaughan for the layman. Dr. Vaughan recently died and his friend, Dr. Black, has made certain revisions to bring the book up to date.

The advice and comments on allergy are well founded and in keeping with the accepted ideas of this disease. The style of writing is ingratiating and the illustrations are most humorous and well chosen. The book fulfils a need and can be readily recommended to patients with allergy.

PHYSICAL MEDICINE ABSTRACTS

Treatment of Multiple Sclerosis. A Review of Drug Therapy. George A. Schumacher.
J. A. M. A. **143**:1241 (Aug. 5) 1950.

A study of the main body of the literature in English concerning drug therapy in multiple sclerosis during the past fourteen years, that is, since Brickner's compilation and Putnam's analysis thereof, makes it apparent that the agents used fall into two main categories: (1) those directed toward preventing the development of lesions in the nervous system, that is, dealing directly with pathogenesis of the disease, and (2) those directed toward modifying the dysfunctions that result from nervous system defects in the patient, in other words, symptomatic remedies. Of the latter, these drugs reputed to improve muscle spasticity have been the center of greatest interest recently. It is to be emphasized that no category of therapeutic agents has been reported or even suggested as capable of healing the primary lesion of multiple sclerosis itself, whether acute and potentially reversible or chronic and presumably irreversible. Nevertheless, from some of the reports of favorable response to drug therapy, in which the agents are not being used as symptomatic remedies, it must be assumed that the authors are implying indirectly an action on the lesion itself.

In the report by Scheinker a "striking myasthenia-like fatigability of skeletal muscle was an extremely frequent complaint of most patients" in a series of 40 cases observed. "Excellent results" are claimed in a number of cases with "generous administration of neostigmine." This therapy is said to have provided "tremendous help in combating increased fatigability, in relaxing spastic muscles and in facilitating voluntary innervation." The conclusions are impaired by the statement that the best effect was obtained by supplementing the drug therapy with muscle exercises.

Of the drug treatment of multiple sclerosis, it may be said that the outlook for cure of the disease by use of drugs is unpromising and that the outlook for symptomatic relief by drugs is less optimistic than would appear from the large number of reports which make claims of favorable effects. The claims for both types of drug therapy would seem in many instances to be unwarranted. Frequently the approach to drug therapy, with several notable exceptions, has not been scientifically sound. In general the studies are insufficiently documented, and both rationales and conclusions are based on insufficient precise scientific data. Conflicting and incompatible data with resultant opposing theories appear in the works of different and the same investigators.

No case of unequivocal cure of established multiple sclerosis is on record. No case of complete relief of symptoms of significant duration has been proved to be due to a therapeutic measure. No study statistically summarized advances a sufficiently high percentage of good results in a significantly large number of patients to warrant general use of the method in question by practicing physicians (except as a means of further experimental investigation).

Blood Temperature and Its Control. H. C. Bazett
Am. J. M. Sc. **218**:483 (Nov.) 1949.

Blood temperature is a term often used loosely, in which blood temperature is confused with body temperature. Blood temperature is usually thought to be regulated at some constant level. It is in no way constant. It shows great fluctuations from time to time and from place to place, and controlled fluctuations in peripheral vessels are utilized to regulate the temperature in the central vessels at a more or less constant level. The blood acts as a common carrier of heat from one area to another, a function which is incompatible with a constant thermal load. The regulation of this circulatory function appears to depend on at least three mechanisms; the direct reaction of blood vessels to temperature levels; reflex responses to thermal sensations; and the reactions of two reciprocal centers in the hypothalamus to the temperature levels to which they are exposed, through which the temperature of the blood supplying them is regulated.

According to the author, one may conclude that current theories of thermal control are not grossly in error, even though the evidence on which they are founded, is by no means reliable. A theory, such as that advanced years ago by Meyer, supposing the existence of two opposing centers, one in the anterior hypothalamus controlling heat dissipation and one lying more posteriorly controlling heat conservation, still seems adequate. Presumably the former center is stimulated by sensations of warmth and has an optimal temperature for activity, which lies above the normal hypothalamic temperature, while the latter is stimulated by sensations of cold and has an optimal temperature below the normal level. The combination of reactions initiated either reflexly or centrally through these centers is reinforced and maintained also by local reactions of the cutaneous and deeper blood vessels themselves to temperature levels, as far as the vascular components of the reaction are concerned.

Such an hypothesis, however, fails to account for regulation of central body temperature at higher levels during exercise, as described by Niel-

sen. Such levels vary with the metabolic loads imposed by the work and appear to induce higher temperatures for the working muscles at the higher loads. These changes seem to be beneficial and to aid efficiency. This adjustment, if properly understood, might throw light on the underlying mechanisms of thermal control in general. It might equally be induced by modifications of peripheral sensation as by alterations in the hypothalamic centers. However, the effects of carbon dioxide on skin sensations and of exercise on sweating seem to oppose any theory of a peripheral origin for the phenomenon. The mechanisms concerned in such adjustments remain completely unknown.

Stocking-Holder for the Stiff-Jointed. L. C. Dundas Irvine.

Lancet **6570**:199 (July 30) 1949.

One of the greatest hardships of the man or woman with severe osteoarthritis or ankylosis of the hip or knee-joint is the inability to put on their socks or stockings and shoes unaided. A simple apparatus has been devised, which consists of two light strips of metal jointed as a T on the flat, the shorter piece being curved into a half round. This half round is furnished with three studs, placed one in the center and one at either end; and three lengths of elastic, fixed by a screw to the handle, carry ordinary suspender fastenings which will clip on to the stud. The user has only to fix the top of the stocking or sock on the three studs when it will hang in an open loop into which the foot can be easily inserted and the whole drawn up the leg. The handle or long end, shaped like a shoe-horn, renders equally easy the slipping on of an elastic-sided shoe or a court shoe. Unfortunately it has not so far been possible to devise an instrument to draw tight and tie shoe laces.

Present Concept of the Therapy of Ocular Syphilis. David O. Harrington, and Randall W. Henry.

Am. J. Ophth. **32**:806 (June) 1949.

The dire need of a rapid and effective therapy of syphilis, brought on by the war years, stimulated intensive study and research along these lines, the results of which are far-reaching. A new interest in syphilis has been awakened and a new concept of its therapy is being established. In the midst of the evolution, it behooves us to survey the opinion of leading men in this field and to formulate conclusions which will guide us to a better understanding of its treatment. Fever therapy still holds an important place in the therapy of ocular syphilis, being unsurpassed in the treatment of primary optic atrophy. Combined fever and penicillin therapy may prove to be the most effective method, especially in the late stages of syphilis. It is important to keep in mind the necessity for careful follow-up treatment on all cases of syphilis regardless of the method of therapy and to remember that lapses, relapses and reinfections occur, which may be hazardous to the patient and to the public-health program.

Tennis Elbow. Leland L. Swenson.

J. Michigan M. Soc. **48**:997 (Aug.) 1949.

Treatment depends on the severity of the condition. In mild or early acute cases, the patients are instructed in the use of heat on the elbow followed by gentle massage. A sling may be worn. Patients are instructed to work with their elbows close to their bodies, not to reach and grasp or do any motion which causes pain. Some writers advocate plaster immobilization, e. g., the use of a cock-splint, or splinting the forearm in neutral with the elbow at ninety degrees. In the more chronic and severe cases, manipulation under local anesthesia may be employed.

Sixty-three cases of "tennis elbow," studied during the period 1946 through 1947, are analyzed. Conservative measures, consisting of heat, massage, rest and avoidance of motions causing discomfort, are generally successful. These measures are particularly successful in treating medial epicondylitis. Manipulation under local anesthesia was successful in 77 per cent of the cases wherein it was used. Roentgenotherapy was 50 per cent successful in four cases. Incision of the conjoined tendon was successful in eight cases that had proven resistant to other forms of therapy and in one case where it was the only therapy employed.

Poliomyelitis — An Hypothesis of Its Etiology. James G. Cumming.

Military Surg. **107**:102 (Aug.) 1950.

The purpose of this paper is to present evidence that poliomyelitis, as a disease, is primarily the result of the carrier state and secondarily the result of auto-inoculation of nerve tissue through an accidental or natural wound.

Rabies is strictly neurotropic while poliomyelitis has only a facultative neurotropism. In both diseases the virus must gain entrance to the insulated nervous system through disrupted nerve fibers, disruption by natural wounds — deciduous teeth, man-made wounds — tonsillectomy, or accidental wounds.

The virus introduced into the wound must have contact with the axon protoplasm of disrupted nerve fibers. The virus progresses along nerve fibers and trunks to the central nervous system. In fatal cases the virus is found in the brain and spinal cord.

The carrier state of poliomyelitis may be prevented by an increasingly higher standard of personal hygiene and sanitation. Appropriate cleansing and disinfection of wounds, natural or accidental, must be practiced for the prevention of auto-inoculation.

The Care of Hand Injuries: Fractures and Dislocations.

J. Kansas Med Soc. **51**:339 (July) 1950.

(Note: This is the fifth of a series of articles on "The Care of Hand Injuries." This material is prepared by the American Society for Surgery of the Hand and is distributed by the Committee on Trauma, American College of Surgeons, through its regional committees.)

Restoration of function: During the healing process, all joints not necessarily immobilized should be freely moved to activate their controlling muscles and their use by the patient encouraged. Following establishment of healing or firm union, restoration of function is secured by directed active motion, particularly through the means of exercise and occupational therapy.

Facial Palsy and Poliomyelitis. Thomas Stapleton.

Lancet **257**:510 (Sept.) 1949.

The possibility of an association between isolated facial palsy and poliomyelitis has been considered previously. Lavergne, et al., were able to find records of over 30 cases of isolated facial palsy which had been attributed to this infection.

The observers in Malta attributed their cases of isolated facial palsy to poliomyelitis because of the absence of other causes, because of the presence of the same kind of general disturbance and because of their occurrence during an epidemic period. The first of these criteria applies to all the cases of isolated facial palsy in the present series and the last applies to 7 of the 8 cases. Only 4 of the 8 had any associated malaise.

Though there is a suggestion that the cases of facial palsy unaccompanied by other paralysis had a cause in common with the cases of poliomyelitis, this hypothesis is not, of course, proven. The numbers were small; the cases of facial palsy seen in the outpatient department may not have been a true reflection of the incidence; the notification figures of poliomyelitis, in view of the difficulties in diagnosis, only give an indication of the time of the epidemic; and the concurrence of the outbreaks was only observed during the one year.

Basic Principles in the Diagnosis and Treatment of Fractures. Allen F. Voshell.

Am. Practitioner **1**:8 (Jan.) 1950.

Although there have been many advances and changes in the methods of treating fractures due to the development of newer metals and appliances, chemicals and drugs, etc., the problem still is one of reducing and immobilizing the bone fragments until sufficient union takes place to allow the use of physical and occupational rehabilitation. The bones and joints of our forebears were of the same type and character as ours, and nothing has altered the basic anatomic and physiologic features of these structures or the changes incident to injury or disease. The newer means and wider range of travel, the use of more machinery, in brief, the more complex and intricate existence of human beings these days, have caused the development of many more of the severer types of injury, such as comminuted and compound fractures, but a very great number of fractures still are due to falls, and leverage forces of various kinds. In consequence, no hesitancy is felt in discussing features of diagnosis and treatment of apparently elementary and fundamental character based on the mechanics of anatomy and the physiologic changes of development. Experience shows that too much dependence is being placed upon gadgets and machinery in the care of fractures and not enough on conservative, sound brain work and an understanding analysis of the whole problem; the latter includes the patient, the mechanics of the cause of fracture, the simplest treatment method consistent with the best result in the end with the least risk and loss of time, early use of physical and occupational therapy, psychologic, social and economic adjustment, and similar factors.

Painful Feet. M. G. Food.

Practitioner **163**:229 (Sept.) 1949.

Experience obtained in the army in a large number of cases seems to confirm the view that the syndrome of painful feet, whether or not associated with flat foot or similar anomalies, is not infrequently due to a muscular disease of the foot, foot myalgia. The muscles commonly affected are the flexor hallucis brevis, the flexor digitorum brevis, the peroneus brevis and the Achilles tendon. The objective signs centering round the "myalgic spots," which can be located by objective criteria, are described. Injection or procaine is recommended for relieving this pain, restoring the function of the diseased muscles in a short time and leading to a rapid cure. It is suggested that the injection of procaine be used in all cases of painful feet, not accounted for by any organic disease, as a diagnostic test in order to prove conclusively whether or not a given pain is of muscular origin.

High Heels and Low Heels. Norman C. Lake.

Practitioner **168**:221 (Sept.) 1949.

The consequences of wearing high heels is formidable enough and there can be little doubt that there is nothing to be said medically in favor of such a fashion. This article is not concerned with the treatment of the various resulting deformities, but it must be emphasized that when patients first present themselves for relief the conditions have usually been too long established to permit of radical replacement, nor can high heels be abandoned immediately, owing to the "set" of the foot. The most that can be done is to afford as much ease as possible by palliative measures.

It is only too clear that the correct way to deal with these conditions is prevention, but there is little hope of doing this unless fashion can be made subservient to anatomical and physiologic demands; this involves a difficult psychologic problem that so far has defied solution.

Electromyography in Diagnosis of Nerve Root Compression Syndrome. Paul A. Shea; Ward W. Woods, and Delbert H. Werden.

Arch. Neurol. & Psychiat. **64**:93 (July) 1950.

Recent advances in electronics have made possible the clinical use of electromyography in the diagnosis of neurologic lesions. In compressive lesions of nerve roots the electromyographic method has a high degree of accuracy in determining not only the presence of such a lesion but also its exact location. Electromyography which utilizes needle electrodes placed intramuscularly in direct contact with the fibers and a cathode ray oscilloscope is more accurate than the method using percutaneous electrodes and an ink-writing recorder. The use of electromyography in conjunction with clinical examinations and ethyl iodophenylundecylate myelography results in a more accurate and an earlier diagnosis in cases of the spinal nerve root compression syndrome.

Disintegration of Motor Function Resulting from Cerebral Lesions. D. Denny-Brown.

J. Nerv. & Ment. Dis. **112**:1 (July) 1950.

Neurologic disorders indicate that, in so far as disorders of sensory, cerebellar and cortical structures bring imperfection to willed movement, each of these structures must contribute to its normal performance. Even though destruction of the precentral gyrus in man has a devastating effect on movements of the limbs of the opposite side, the loss is not absolute. Full understanding of the significance of the motor functions of the cerebral cortex awaits more knowledge of the adequate stimulus for activation of each area.

The behavior of the grasp reflex, instinctive grasping, and the placing reaction indicate that the rolandic cortex is concerned especially with the conditioning of proprioceptive stretch reflexes by contactual effects. The tactile component of this mechanism is not the same as that which perceives touch or pressure, and has tonic, continued, effects as well as special phasic and specific reactions.

Orienting movements of the head, eyes, mouth and limbs are served by extra-rolandic regions of the cortex. Within this system removal of the modulation provided by the cerebral cortex, as in frontal lobe lesions, results in some fixity of the righting reactions, giving a general rigidity.

The rolandic cortex also exerts control over the tegmental mechanism, but in a sense opposite to that of the extra-rolandic cortex, as shown by the opposite primary movement response to stimulation of these two divisions of cortical motor function after pyramid section. Posture and movement are not separate entities, because all types of movement have the nature of facilitated fragments of postural reactions.

The rolandic and extra-rolandic cortex contribute complementary features to movement. Their interrelationship is such that disorder of one leaves unopposed unwanted activity of the other. Such activity is that which the clinician has habitually called extrapyramidal, but the movements concerned are the result of incoordination between the two systems, and not the special function of one or other. The bizarre postures of athetosis and dystonia have meaning only as conflicting extremes in the pattern of control of the basic organization of the tegmental mechanism by rolandic and extra-rolandic cortex. There is thus no "center" for spasticity, rigidity or involuntary movements nor may a "pathway" be expected for these functions. Each is the outcome of partial or complete release of a normal component in movement from its natural competitor.

The Comparative Effects of Water, Carbonated Water, Sodium Chloride Solution, and Sodium Bicarbonate Solution on Gastric Acid Secretion in Human Subjects. Edward H. Hale; A. C. Ivy, and M. I. Grossman.

J. Lab. & Clin. Med. **35**:249 (Feb.) 1950.

From time to time one sees or hears the statement that carbonated water or sodium bicarbonate stimulates gastric secretion in the human being. The experiments which have been done with sodium bicarbonate alone (i. e., with no other stimuli for gastric secretion) are too few in number and too variable to permit interpretation. No experiments with carbonated water in human subjects could be found.

This study was performed to determine whether carbonated water or sodium bicarbonate had a significantly different effect from an equal quantity of plain water or sodium chloride solution on the secretion of acid by the stomach of human subjects. Observations were also made on the rate of the gastric evacuation of these solutions from the stomach.

In normal human subjects: (a) carbonated water does not stimulate gastric secretion or affect gastric emptying to any greater extent than noncarbonated water; (b) isotonic sodium chloride and isotonic sodium bicarbonate solutions leave the stomach at about the same rate. In duodenal ulcer patients isotonic sodium bicarbonate solution leaves the stomach more rapidly than isotonic sodium chloride solution. In contrast to distilled water, isotonic sodium chloride solution does not stimulate gastric acid secretion.

The Choice of the Physician . . .

THE PROFESSIONAL SPECIAL Ultraviolet Lamp (QA-450-N)

efficient . . . convenient . . . economical

● Clinically effective ultraviolet irradiation. Directed in a horizontal or vertical plane, or at any intermediate angle, ultraviolet rays strike the treatment area at the proper angle of incidence.

The Burdick Professional Special conserves time — is adapted to all technics of hot quartz spectrum ultraviolet irradiation. Powerful . . . automatic starting . . . economical in cost and operation.

Burdick

THE BURDICK CORPORATION

MILTON, WISCONSIN

MEDITRON
ELECTROMYOGRAPH
Model 201A (Pat. Pend.)

- MYOSCOPE RECORDING
- OSCILLOSCOPE
- RECORDING CAMERA
- INTEGRATING METER
- INTERNAL CALIBRATOR
- LOUD SPEAKER
- A-C OPERATION
- YEAR FREE MAINTENANCE

CONTINUOUS RECORDINGS

The Myoscope provides an inexpensive method for obtaining continuous recordings of the electromyographic examination on magnetic tape. When played back through the electromyograph, the Myoscope recordings enable the examiner to see, hear, and photograph the muscle voltages as they were recorded during the original examination.

THE MEDITRON COMPANY
1060 E. Green Street, Pasadena 1, Cal.

MEETINGS OF INTEREST TO THOSE IN THE FIELD OF PHYSICAL MEDICINE

In this column will be published information about meetings of interest to those in the field of physical medicine. New data should be sent promptly to the office of the ARCHIVES, 30 North Michigan Avenue, Chicago 2, Illinois.

American Congress of Physical Medicine. — 29th Annual Session, Shirley-Savoy Hotel, Denver, Colo., Sept. 4, 5, 6, 7, 8, 1951. Walter J. Zeiter, M.D., Chairman, Convention Committee, 30 North Michigan Ave., Chicago 2.

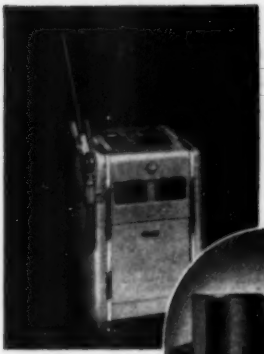
New Jersey Society of Physical Medicine. — Meetings, fourth Wednesday. Bror S. Troedsson M.D., President, Orange Memorial Hospital, Orange, N. J.

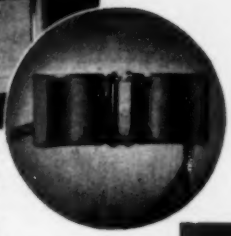
New York Society of Physical Medicine. — Meetings, first Wednesday. Madge C. L. McGuinness, M.D., Secretary, 48 E. 62nd St., New York 21, N. Y.

Pennsylvania Academy of Physical Medicine. — Meetings, third Thursday. Herman J. Bearzy, M.D., Secretary, 289 N. Maple Ave., Lansdowne, Pa.

Section on Physical Medicine and Rehabilitation of the Southern Medical Association. — In conjunction with meeting of the Southern Medical Association, November 12-16, 1950, St. Louis, Mo., the Section on Physical Medicine and Rehabilitation will be held Wednesday Afternoon, November 15, 1950. Chairman, Walter J. Lee, M.D., Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia, Richmond 19, Virgina.

Chicago Society of Physical Medicine and Rehabilitation. — Meetings, fourth Wednesday, Oct., Nov., 1950, and Jan. through May, 1951. Next meeting Nov. 22, Michael Reese Hospital, Chicago. Arthur A. Rodriquez, M.D., Secretary, 30 North Michigan Ave., Chicago 2.





Choose Your Short Wave Diathermy Wisely

FISCHER De Luxe Model 400 offers . . .

Inductance Applications with the
PATENTED ADJUSTABLE INDUCTION ELECTRODE,
or inductance cable

Condenser Electrode Applications with
AIR SPACED ELECTRODES, pads and other designs

Minor Electrosurgery and any degree of Coagulation

FISCHER De Luxe Model 400 is the highly efficient, practically trouble-free, self-excited oscillator type—no crystal control or master oscillator.

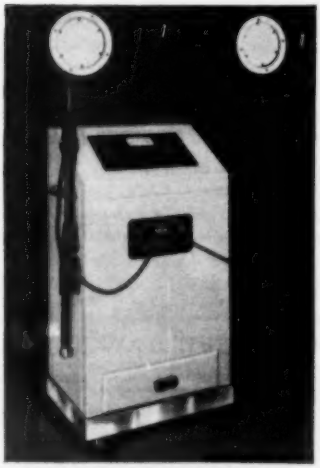
ACCEPTED
COUNCIL ON PHYSICAL MEDICINE
AMERICAN MEDICAL ASSOCIATION

- A.M.A. ACCEPTANCE
- F.C.C. TYPE APPROVAL D-500
- UNDERWRITERS' LABORATORIES APPROVAL
- CANADIAN TYPE APPROVAL Number 7

Patented Adjustable Induction Electrode, designed especially to fit any part of the body, gives even distribution of heat over entire treatment area.

Write for FREE copy of Federal Communications Commission's questions and answers digest of regulations on operation of medical diathermy equipment.

H. G. FISCHER & CO. • Franklin Park, Illinois



Hogan Brevatherm Model No. 8920

STILL IN FRONT

McIntosh Short Wave Diathermy Equipment is still in the lead.

New engineering makes the Hogan Brevatherm Model No. 8920, F. C. C. Type Approval No. D-528, an outstanding value with ample power for the busy hospital or clinic and most sensitive control of output. You who have used diathermy equipment of our make for a third of a century (half of our life-time) are best able to judge the correctness of our assertion.

McINTOSH ELECTRICAL CORP.

72nd Anniversary, Feb. 4, 1951

227 N. California Avenue Chicago 12, Illinois

☐ Literature please on Model No. 8920.
☐ Please have representative call

DR.
ADDRESS
CITY STATE

A. P. M.

The Golseth-Fizzell Model DS

CONSTANT CURRENT IMPULSE STIMULATOR

U. S. Pat. No. 2498882

A portable, scientifically designed stimulator which provides physical therapy and the following diagnostic and prognostic aids.

Galvanic tetanus ratio — rheobase and chronaxis measurements — strength duration curves — and repetitive stimuli tests. An electronic circuit automatically produces pre-set galvanic stimuli, adjustable in strength from 0 to 25 ma. and in duration from 1 ms. to 1½ seconds.

Please Write for Additional Details.

CHICAGO MEDICAL ELECTRONICS LAB., INC.

6425 N. Avondale Chicago 31, Ill.

Georgia Warm Springs Foundation
GRADUATE COURSE

Physical Therapy and Occupational Therapy in the Care of Poliomyelitis

This course is open to graduates of approved schools in physical therapy and occupational therapy. Such graduates must be members of the American Physical Therapy Association and/or the American Registry of Physical Therapy Technicians, and Occupational Therapy Association.

Tuition: None. For Scholarship to Cover Transportation and Maintenance Contact, National Foundation for Infantile Paralysis, 120 Broadway, New York 5, New York.

Entrance Dates: First Monday in January, April, July and October.

Duration of Course: The Course is divided into two parts:

Part I. Over-all care of convalescent polio with particular emphasis and special training in muscle testing and muscle reeducation.

Part II. Particular emphasis and special training in functional testing and functional retraining.

Each Part lasts three months and only selected students who have completed Part I will be admitted to Part II. All students applying for Part I must be willing to remain through Part II if selected.

For Information Write:

ROBERT L. BENNETT, M.D.
Georgia Warm Springs Foundation
WARM SPRINGS, GEORGIA

In that precious instant when newborn life hangs in the balance . . . the dependable E & J resuscitator can mean victory . . . and the first welcome cry of *life*.

The E & J machine adjusts itself to even the tiny lungs of premature infants, signals the operator when aspiration is required to remove mucus or other foreign matter, breathes for the baby until natural breathing is firmly established.

The equipment enables your hospital to take positive, effective action when there is acute danger of a newborn life slipping away forever. You may see a demonstration at no obligation... just write or phone any of the offices listed.

The Breath of Life

RESUSCITATOR
ASPIRATOR
INHALATOR

E & J MANUFACTURING CO.
Glendale 1, California

Sales Service Centers: Philadelphia, Pittsburgh, Boston, New York, Chicago, Oakland, Seattle, Salt Lake, Detroit, San Antonio.

CHANGE OF ADDRESS

Send your new address at least 30 days before the month of the issue with which it is to take effect. Address

THE ARCHIVES OF PHYSICAL MEDICINE
30 North Michigan Avenue, Chicago 2, Ill.

Send old address with the new, enclosing if possible your address label. The Post Office will not forward copies unless you provide extra postage. Duplicate copies cannot be sent.

OPPORTUNITIES AVAILABLE

WANTED — PHYSICAL THERAPISTS FOR FOLLOWING: (a) Senior physical therapists for physical rehabilitation and cerebral palsy departments; orthopedic hospital handling all types of orthopedic departments; East. (b) Group appointment, 16-man clinic, all Diplomates or Board eligible; divided case load; university town of more than 100,000. Midwest; minimum $5000. (c) New school for handicapped children; staff comprised of two speech therapists, physical therapist, pre-school teacher; winter resort city of 100,000 located on Atlantic seaboard, South. (d) To head department, large general hospital; leading city of United States dependency; although tropical country, climate mild; interesting opportunity. (e) Rehabilitation center; university connection; East. (f) School position; duties consist of conducting program for handicapped children; college town, Pacific Northwest. (g) To head department, 10-man clinic; winter resort town, South. (h) To assist orthopedic surgeon, Diplomate of American Board; duties consist chiefly of fracture cases, nerve injuries, poliomyelitis, etc.; college town of 70,000, Southwest. (i) Convalescent unit of orthopedic institution; broad program; college town, Southern Michigan.

For further information, please write Burnette Larson, Medical Bureau, Palmolive Building, Chicago.

aloetherm

newest and finest in

crystal controlled

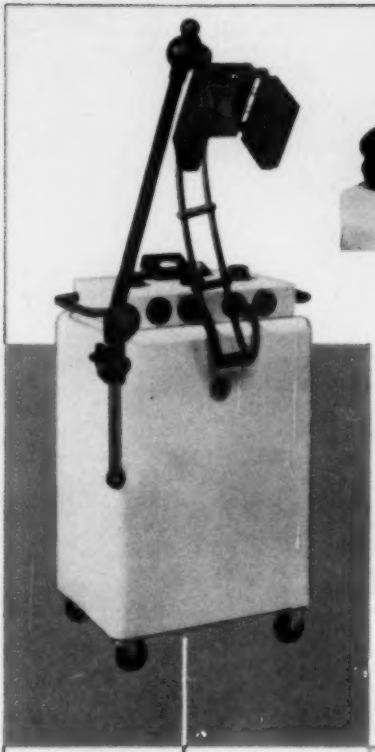
short wave diathermy

New crystal controlled Aloetherm answers all modern requirements for short wave diathermy. The equipment is efficient and practical in design, rugged, precision construction. It is built exclusively for Aloe to Aloe standards. Full type approval No. D-482 has been awarded the Aloetherm by the Federal Communications Commission. Exceptionally handsome appearance. Available for immediate shipment. Backed by our full two year guarantee. Truly quality equipment yet sold at the lowest price on the market. Write for illustrated literature.

20F7300—Aloetherm Crystal Controlled Short Wave Diathermy complete with Electromagnetic Treatment Drum, Electromagnetic Inductance Cable with Spacers, Flexible Arm, and Line Cord..... **$725.00**

A. S. aloe COMPANY *Serving the Profession Since 1860*

1831 Olive Street • St. Louis 3, Missouri



use the large area technic..

with the BIRTCHER *Crystal* BANDMASTER

SHORT WAVE DIATHERM WITH THE TRIPLE INDUCTION DRUM

The application of this large-area technic is being widely recognized as the outstanding advantage of short wave diathermy over other methods of producing heat in the tissues. The Birtcher Crystal Bandmaster Diatherm with the Triple Induction Drum provides better diathermy application. The Triple Drum affords treatment of convex and concave parts, with one setting of drum. Energy is distributed evenly over treatment area providing more uniform heating. Since the total area of the Birtcher Triple Induction Drum is larger than conventional round drums, the energy emitted *per square inch* is reduced. Considerable total energy may be introduced into the deeper tissues without excessive heating of the outer surfaces.

THE BIRTCHER CRYSTAL BANDMASTER DIATHERM

The Birtcher *Crystal* Bandmaster Diatherm approved or accepted by the following:

- F.C.C. Approval Number D-474.
- A.M.A. Council on Physical Medicine.
- Underwriters' Laboratory Approval Number E-6801
- Canadian Standards Assn.
- Canadian Dept. of Transport

Ask for more information about the Birtcher Bandmaster and the Triple Induction Drum.

THE BIRTCHER CORPORATION • LOS ANGELES 32, CALIFORNIA